

POPULAR SCIENCE

MONTHLY



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Newest "Amphibs" for Invading Japan . . . Page 121

WHAT RADAR IS-HOW IT WORKS-P. 65

HERE IT IS THE MOST USEFUL

Here, in one great, brand-new volume is **EVERYTHING** you need to know to do **ANY** job in or around your home—repairs, alterations, improvements, and new projects.

The Home Mechanic's Handbook

JUST A FEW OF THE PRACTICAL JOBS FULLY DESCRIBED

How to choose the right paint for every job
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Build a chicken house, cupboard, workbench, cold-bed frame, storage cabinet
Cut, drill, grind, solder, temper, and forge metal
Measure, cut, thread, join, and assemble pipe
Fix leaks in faucets and valves
Thaw frozen pipes
Install a hot-water heater
Make a flagstone walk, a sidewalk, a wall, concrete steps, a shuffleboard
Build a brick fireplace
Install glass blocks

Install a call-bell system, a front-and-rear-door system, a door-opener circuit, or a burglar alarm
Locate a short circuit
Repair electrical equipment and appliances

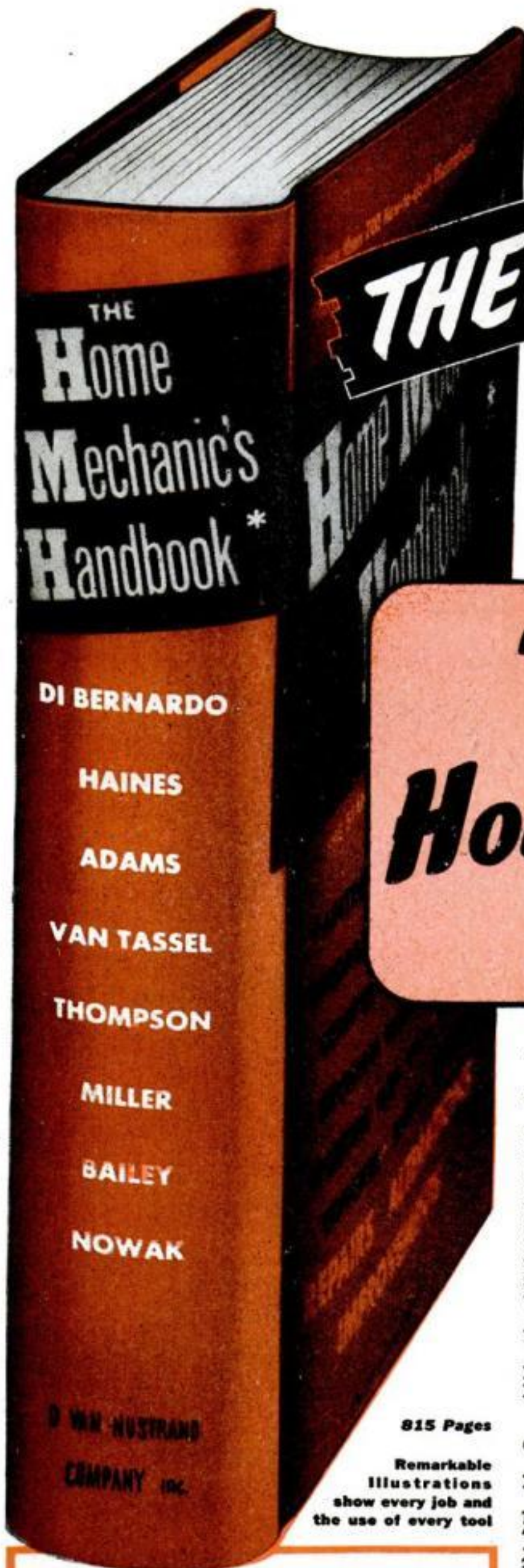
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show every job and
the use of every tool

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This One



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COMPLETE INFORMATION ON EVERY PRACTICAL TRADE

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Turn to this comprehensive HANDBOOK with confidence. You will find its helpful pages crammed with the latest, most efficient and workmanlike ways of doing every kind of job about the home and in the home workshop. Carpentry, metal work, electrical work, plumbing, masonry, painting and decorating—all explained by master craftsmen. The most detailed information about how to choose, repair, and apply the right materials in the right places.

Every move in the use of tools is shown by vivid hands-at-work photographs. All the important operations, and those "tricks of the trade" that play so great a part in good craftsmanship, are explained and made crystal clear by detailed step-by-step drawings. Complete directions, fully illustrated, for thousands of jobs, small and large—from fixing a broken window to installing a hot-water heater; from varnishing a chair to painting a house.

PAINTING & DECORATING

Principles of paint mixing, formulas, and how to obtain any desired hue. Full directions for selection and care of brushes and other equipment. How to calculate amount of paint required, and best methods of applying to wood, metal, brick, concrete, stone, stucco, plaster. Exterior house painting—interior house painting—choice of color schemes. Complete directions, fully illustrated, for obtaining decorative effects—stippling, mottling, texturing, stenciling, striping, etc. Methods of finishing with stain, shellac, varnish, and wax. Proper stains for each variety of wood. Detailed step-by-step instructions for wall-papering. How to finish an auto, quickly, easily, and inexpensively.

WOODWORKING

The many varieties of wood and their relative merits, working qualities, and uses. Plywoods, veneers, and wood substitutes—how to choose the materials best suited for the job. Sizes, types and functions of all carpentry tools—how to use, sharpen, and adjust them. All the basic operations and processes of woodworking—everything from how to avoid warping to full directions for cutting each of the common joints. Wood turning—the different cuts, roughing, facing, sanding and finishing; drilling, boring, morticing, spinning, polishing. Hundreds of repair jobs and new constructions—inside and outside the house—are fully explained with diagrams and every practical fact you need to get the best results.

METAL WORKING

Complete information about the common metals, and the alloys—wrought iron, cast iron, steel, German silver, pewter, the brasses and bronzes, solders and babbitts—when to use, how to use, and how to work them. Hand tools and machine tools—their specific purposes, sizes, and the most detailed instructions for their use. Hints, ideas, and "tricks of the trade." How to use the engine lathe. Metal jobs and projects for home and shop, complete with bill of material, equipment needed, and a fully illustrated account of every step in the work.

PLUMBING

The various kinds of pipe, pipe fittings, valves, and fixtures. All the common plumbing tools—types, sizes, functions, and how to use them. How to cut, ream, thread, and assemble iron and brass pipe. How to connect copper tubing and make lead joints. The technique of pipe fitting, and the proper sequence of steps in assembling a piping system. Household plumbing projects—installing a hot-water heater, radiator, and various other units. How to drain a plumbing system when closing the house for the winter. How to fix leaks in faucets and valves, repair a faulty section of pipe. The cleaning, and maintenance of each part of the plumbing system.

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Answers every practical question about concrete, plastering, stucco, brick work, concrete-block and glass-block construction. Describes all tools, and just how to use them. How to specify materials and estimate quantities. How to build forms; mix concrete, color it, make it watertight, finish it off; how to build walls, floors, steps. All the sure methods and special ways of working by which the master mason assures good results. Everything about plastering—from small repairs to doing entire rooms. Complete instructions for stuccoing—reinforcing, methods of applying different coats, and how to obtain various decorative finishes. Kinds of brick—handling and laying. Mixing and coloring mortar. Material charts. Types of construction. Various bonds. Forming cross joints. Fire-place construction. Working with concrete blocks—building the wall, corner construction. Kinds and sizes of glass blocks. Glass-block construction—mortar, full-mortar joints, set-in-wood construction.



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Practical information about every electrical job the home mechanic may undertake around the house or in the home workshop. Principles of electricity—volts, amperes, ohms. Generation of electricity. Electrical energy and power. Fuses and circuit breakers. Parallel and series circuits. Standard electrical symbols. Tools, materials, and requirements of National Electrical Code. Complete, fully illustrated explanations of every step in various operations of general electrical work—splicing, soldering, taping, testing, etc. Installation of various signalling systems—bells, buzzers, and alarms. Wiring methods for power and lighting circuits. Complete projects for the home, such as BX wiring a room, and wiring a garage in conduit and BX. Portable appliances—fans, mixers, clocks, heaters, radios. Fixed equipment—oil burners, refrigerators, lighting plants, pumps, motors, generators, and control devices; all clearly described, with practical suggestions and hints for trouble shooting and adjustment.

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The coupon at the right will bring you a copy of The Home Mechanic's Handbook for ten days' examination, entirely free. Look it over, spend some time with it, and decide for yourself whether or not you want to keep it. Unless you are convinced that The Home Mechanic's Handbook is the most useful book you have ever seen, you may return it to us and owe nothing; or you may keep it by making a down payment of \$1.95, plus a few cents postage, and the balance in two monthly payments of \$2.00 each, (\$5.95 plus postage). But send in the coupon NOW! The supply is definitely limited.

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VOL. 147 NO. 3

Mechanics & Handicraft

A TECHNICAL JOURNAL OF SCIENCE AND INDUSTRY

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JAMES L. H. PECK (Page 65) has more than an academic interest in radar. He learned to fly in 1930 and was one of the first pilots to shoot down a modern German fighter. No stranger to Popular Science readers, he is widely known for his articles on aviation. He is now an officer in the U.S. Merchant Marine.

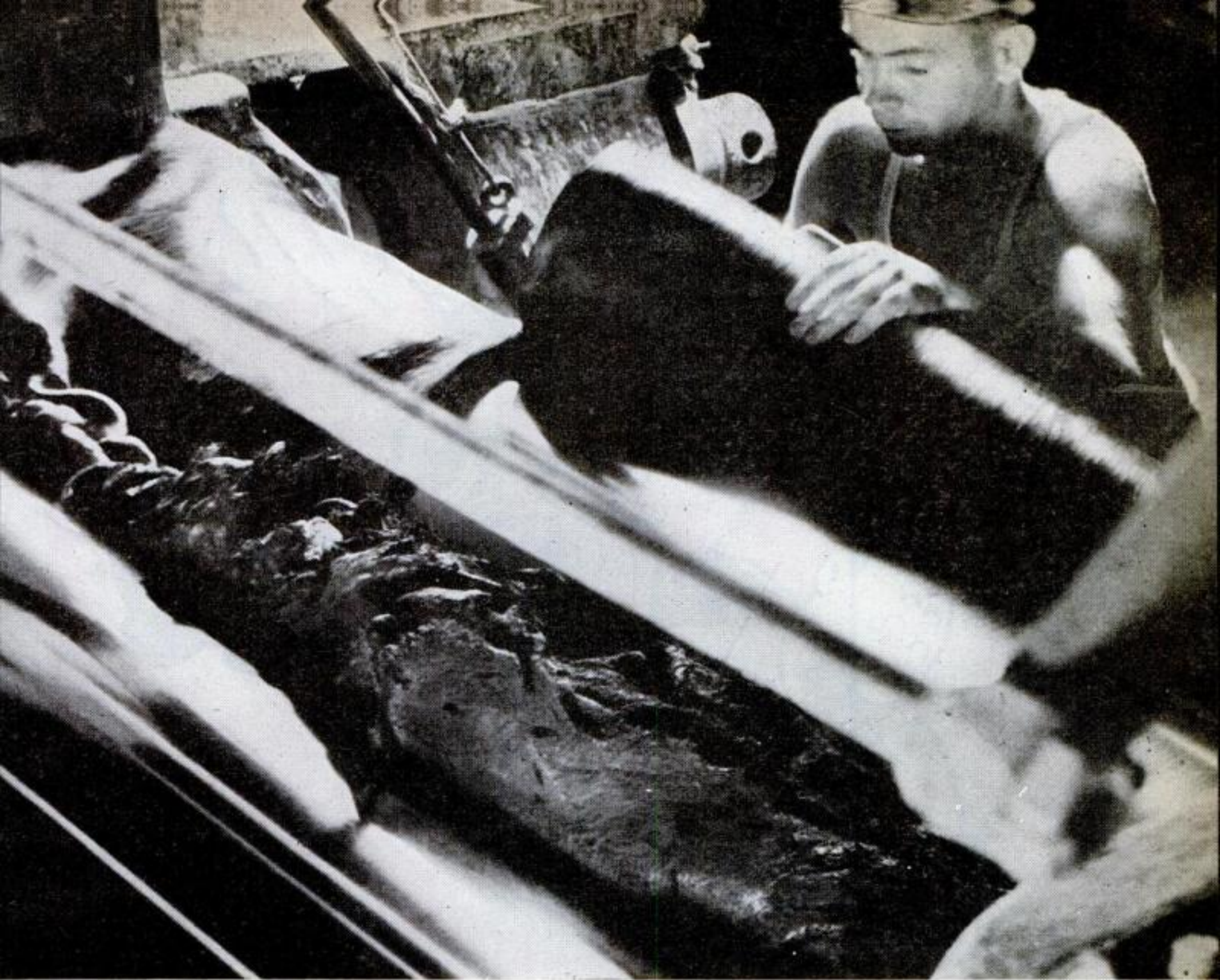
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Announcing a new, better synthetic rubber for tires

Another example of "building for today, testing for tomorrow"

B. F. Goodrich has announced that it is now making tires of a new kind of synthetic rubber, different from the synthetic rubber which is in general use by the tire industry.

The new rubber is a B. F. Goodrich development. Tires made of it give longer wear than those made of ordinary synthetic. They run cooler, which is especially important in big truck tires that often get hotter than boiling water under heavy loads on hot pavements.

The new rubber was actually developed months ago and made

in plants operated for the government by B. F. Goodrich. For a while it was used only in military tires, then in tires for heavy trucks. Now it is also going into new B. F. Goodrich tires for passenger cars. Tires containing it will stand up better under heat or under constant flexing, will wear longer, will even have more resistance to bruising or damage from accident. They'll also have more resistance to cracking, and they'll be able to stand higher speeds.

This new, better rubber, so important it was a military secret until recently, is one more ex-

ample of constant development at B. F. Goodrich—the kind of improvement that will bring America far better products after the war than we ever had before. Yet it's only one of dozens of tire improvements made by B. F. Goodrich in the last few years. It's another indication that you get extra value, extra economy, whenever you buy a B. F. Goodrich tire. *The B.F. Goodrich Company, Akron, O.*

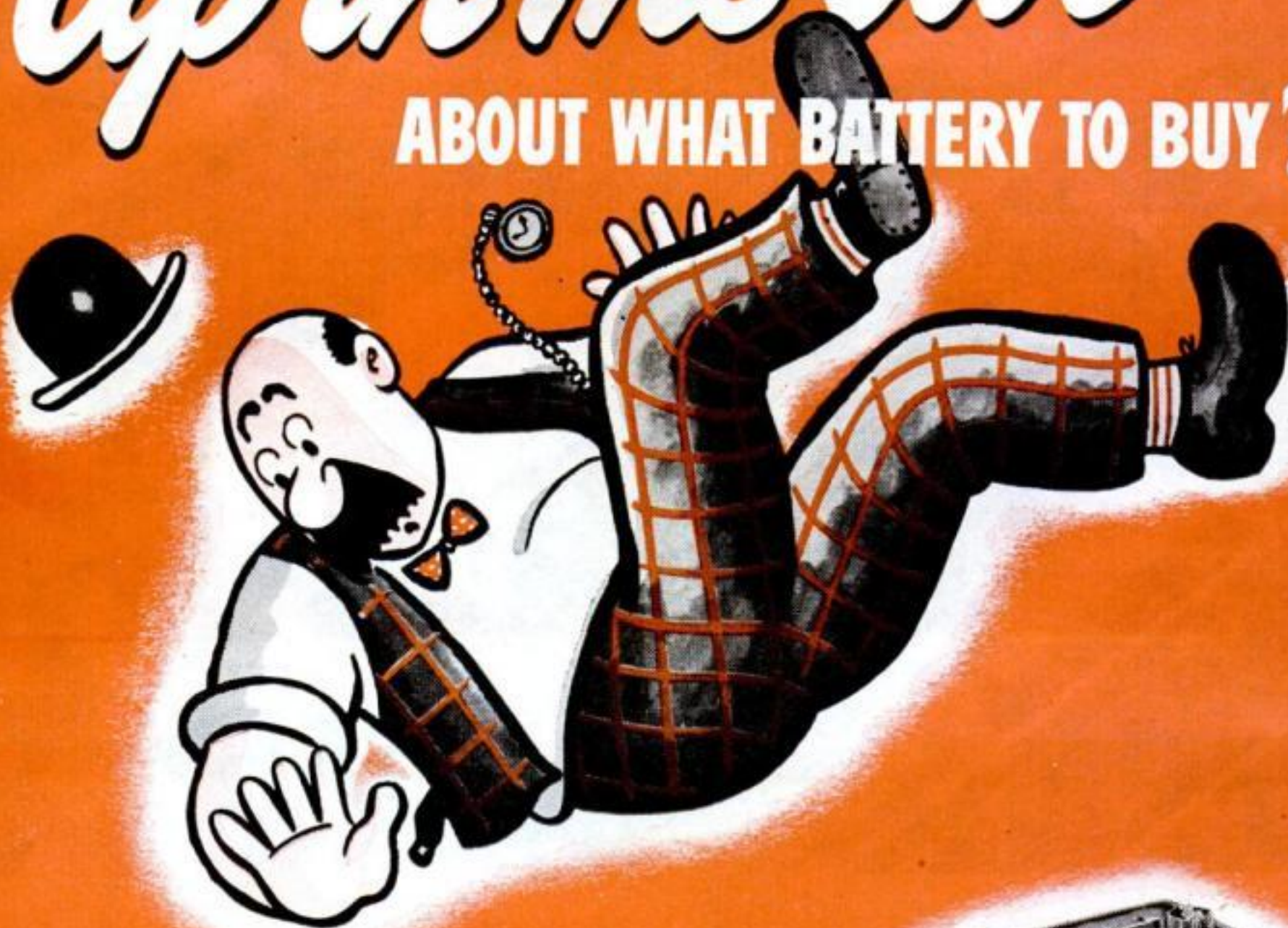
In war or peace

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Up in the Air

ABOUT WHAT BATTERY TO BUY?



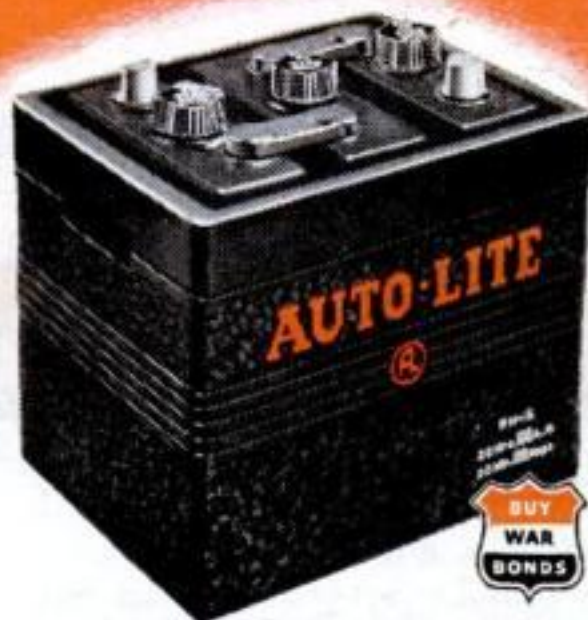
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THE BIRD WITH THE 16-MILE TAIL

The wire you see with the parachute on the end of it is a telephone wire, being payed out from a C-47 cargo plane.

Bell Telephone Laboratories, working with the Air Technical Service Command of the Army Air Forces, developed this idea. It will save precious lives and time on the battlefield.

A soldier throws out a parachute with the wire and a weight attached. The weight drops the line to the target area. From then on, through a tube thrust out of the doorway of the plane, the wire thrums out steadily — sixteen miles of it can be laid in 6 2/3 minutes. Isolated patrols can be linked quickly with headquarters. Jungles and mountain ranges

no longer need be obstacles to communication.

This is in sharp contrast to the old, dangerous way. The laying of wire through swamps and over mountains often meant the transporting of coils on the backs of men crawling through jungle vegetation, and in the line of sniper fire. It is reported that in one sector of the Asiatic theater alone, 41 men were killed or wounded in a single wire-laying mission.

Bell Telephone Laboratories is handling more than 1200 development projects for the Army and the Navy. When the war is over, the Laboratories goes back to its regular job — helping the Bell System bring you the finest telephone service in the world.



BELL TELEPHONE LABORATORIES Exploring and inventing, devising

and perfecting for the Armed Forces at war and for continued improvements and economies in telephone service.

SEPTEMBER, 1945

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5



Coming Next Month

A **COLORFUL LIFE** is in store for you after the war. Homes, offices, and factories will blossom with all the hues of the rainbow as we apply new knowledge of the use of color for beauty, comfort, and safety. To help you share in this brightening-up process, Popular Science publishes a 14-page article, illustrated in color, on the scientific selection of paint shades for any given purpose.

A **BUSINESS OF HIS OWN** was what Salvatore Salvatori wanted when he got his discharge from the Navy. Now he refurbishes old furniture, and fashionable New Yorkers are beating a path to his door. GI's who are looking forward to being their own bosses "after the duration" will be encouraged by the story of this enterprising veteran's success.

SEEING EYE OF ELECTRONICS. Are you up to date on the cathode-ray tube? Until recently only a scientific curiosity, it has found countless new uses under the stimulus of a mechanized war. John W. Campbell, Jr., tells how it works and describes the many kinds of jobs it will perform in the postwar world.

"LOST IN THE ARCTIC!" Those words, once so tragic, have been robbed of much of their terror for airmen who fly above the snowy wastes at the top of the world. Our flyers know that if they are forced down, the Arctic Search and Rescue Squadron will soon be out after them—with planes, sled-pulling huskies, even Saint Bernards. Read C. B. Colby's story of these good Samaritans of the snows.

NOW WE KNOW just how good the Germans' weapons were. Victory has given us the chance to clear up many wartime mysteries by examining and testing guns and vehicles alongside our own. There were many surprises in store for the Ordnance men who made these tests—and for P.S.M. readers who see the results in a comprehensive article next month.

MODEL HELICOPTER. You'll know a lot more about vertical-lift aircraft after building the "Skyhook" model helicopter from plans by Roy L. Clough, Jr. The author has cleverly met the problems that beset all builders of helicopters, big or little, to produce a model that is easy to build—and actually flies.

**are you the
I. C. S.
type of man?**

A large, stylized letter 'A' composed of various symbols like 'c', 's', 'i', 'l', '1', and 'o'. The 'A' is formed by a dense arrangement of these characters, with some characters appearing more frequently than others to create the shape. The top of the 'A' is a wide, shallow curve, while the bottom is a narrow, pointed shape. The interior of the 'A' is filled with a mix of the same symbols, creating a textured, almost pixelated appearance. The overall effect is a high-contrast, black-and-white graphic that resembles a digital or typographic art piece.

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By H. Bennett

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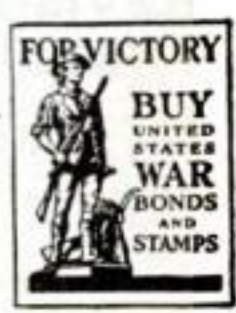
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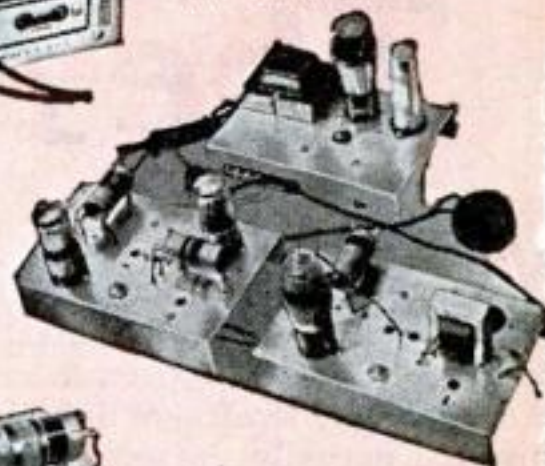
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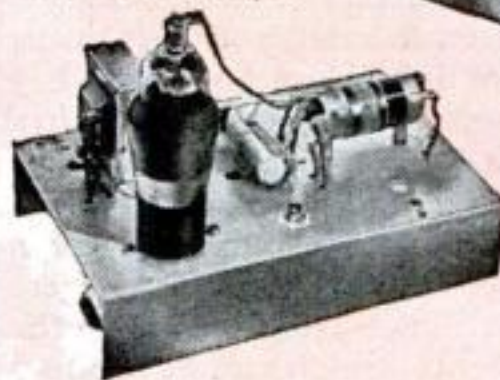
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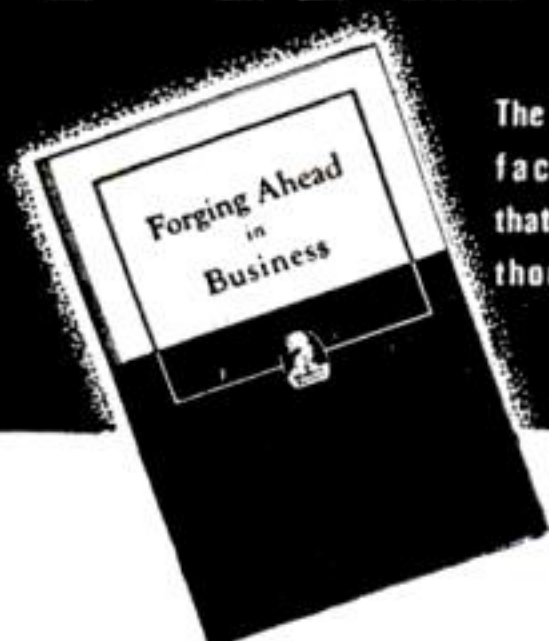
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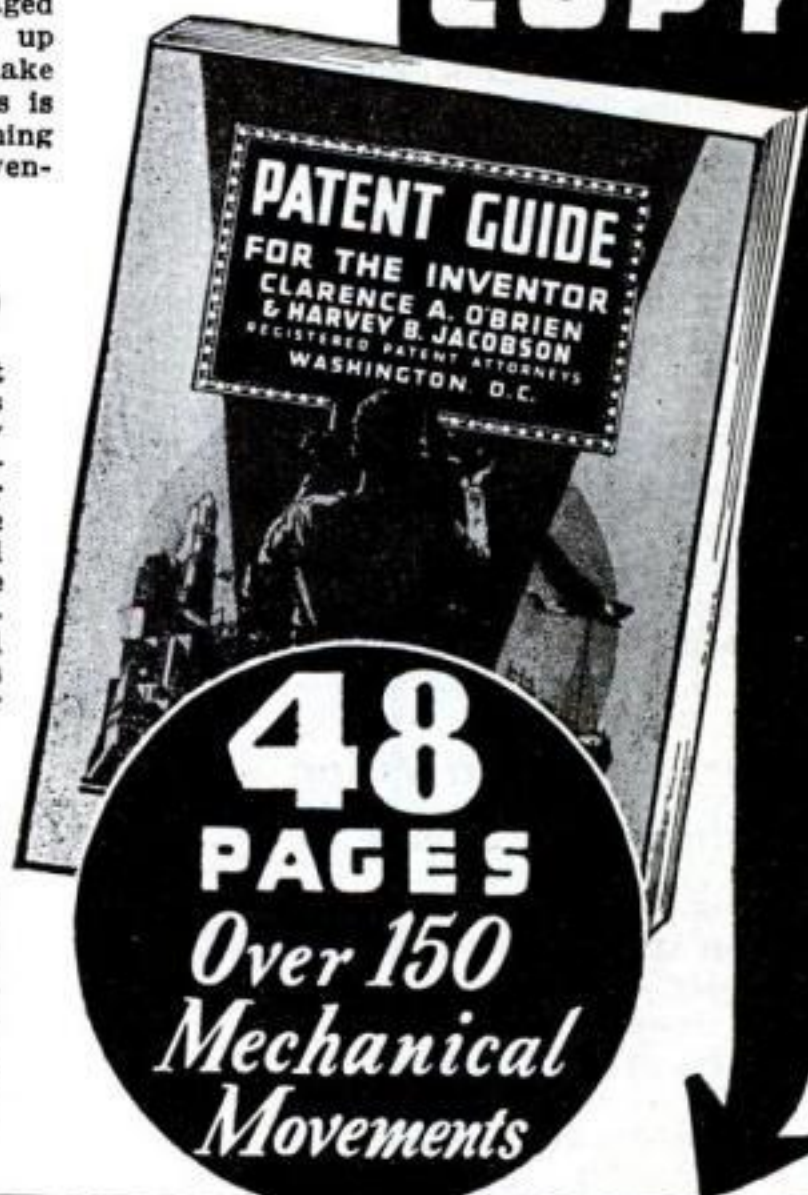
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Readers Say:

Ways to Reclaim Old Fluorescent Tubes

IN ANSWER to B.R.L., there are two uses I can suggest for burned-out fluorescent lighting tubes—one for recreation and the other for utility. Throw a tube into a swiftly flowing stream, and with a .22 caliber rifle shoot off the end. As the tube bobs up higher, keep on shooting until it sinks. For utility, the larger size might be used as the outer tube of a Liebig condenser. Cut off the ends and clean out the fluorescent material; then take two large corks and cut two holes in them. Into these place a short piece of tubing and slide the corks into a tube longer than the fluorescent one. Connect this with rubber tubing to a retort and place the other end over a flask. By running water through the outer tube from bottom to top, you can distill liquids.—W.C.N., Rock Hill, S.C.

This Man Has a Vision of the Ideal Trailer

LIKE a lot of other men, I want to build a house trailer. Present trailers are all right in their way, but they are built primarily for use around tourist camps where electricity and water pressure are available. I want a trailer that carries an independent electric system and water system of its own. I know there are small gasoline-electric generators built, but they are heavy-duty affairs, and they weigh and cost a lot. How about rigging up a very small gasoline motor to drive a car generator and battery system? I think an electric refrigerator would be convenient in a trailer. So would an electric razor.

As for water, the only thing I have thought of is a water tank with air pressure. I see that airplane oxygen bottles are for sale at the war-surplus outlet stores. How would



they do for pressure tanks? Would a built-on hand pump do for it, or could a small compressor be connected to the car motor? Maybe gasoline service stations would let you fill the pressure tank from their air hose for a price.

Butane gas is very nice for cooking. With this and water pressure, it would be simple to have a small water heater, and with hot and cold running water, a shower bath could be arranged. I have been thinking of using Plexiglas for windows, and perhaps a small bomber blister for a skylight. Outside of these things, I would like a gas-operated refrigerator, and I'd like to know if a small one could be made to use butane gas.—J. R. N., Bell Gardens, Calif.

Here Are Suggestions for Braking Power Snow Sled

I HAVE some ideas that may help P. H. with his braking trouble on his power snow sled. The first, and probably the most efficient, way would be to mount a marine transmission between the motor and the propeller that would enable him to reverse the propeller and allow it to serve as a brake. This method would bring him to a complete stop regardless of the snow conditions. Maybe flaps would do the trick. They do all right on Army and Navy fighters and bombers.

They could be closed to lie flat along the fuselage of the sled and opened either hydraulically or electrically. A search of war surpluses now for sale should reveal something usable. What I had in mind was an electrically operated device called an actuator. It would snap the flaps open in a fraction of a second and slow down the sled considerably, although it would not bring it to a complete stop.—A. R., Bedford, Ohio.

A. R. has ideas, but they bring up practical difficulties. A reversible propeller would, more than likely, snap the shaft if it were used suddenly to brake a swift-moving sled. Flaps opened toward the wind would also snap; away from the wind, they would have only a slight effect. Perhaps the drag device used on dog sleds is the best type of brake. It's simply a flexible board fixed to the forward end of the sled and suspended from the rear by a spring. When the operator steps on it, a serrated steel blade at the end digs into the snow or ice and stops the sled.—Ed.



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P.S.M. Spells Relaxation for This Active GI

I'VE BEEN with Patton's army from the day I hit Europe to the mopping-up process that saw the war's end in the European Theater of Operations, and your magazine has given me many moments of relaxation. I can even forget sights like Buchenwald by thumbing my worn copies of *POPULAR SCIENCE*.—Cpl. G. F., APO, New York City.

Gus Wilson Saves Money for a Perplexed Motorist

MY FAVORITE article has always been the story about Gus's Model Garage. Some time ago, I read where Gus's genius for trouble shooting was put to a test in finding a short in a car's wiring system. He discovered it in a wire connecting with the trunk lid of the car. A week ago, at Delaware Water Gap, Pa., I ran into a similar difficulty. At sundown, after driving most of the day with no trouble at all, I switched on my dim lights. They were on for a second, then they flicked off and then on, and so on. Each time they went off, my ammeter flew to full discharge. When I switched them off, the ammeter registered normally until I turned on the lights again. Any position on my light switch gave the same reaction.

For a time I was at a loss for an answer. Then I remembered Gus's case. I pulled over to the side of the road, and asked my wife to look at the rear lights. There weren't any. So then I told her what I had read in *POPULAR SCIENCE*, and I diagnosed the case. Sure enough, when I opened my rear-deck lid, I found that my suitcase was hitting the wire that ran from the body to the deck lid. I removed the suitcase, and my troubles were over. Thanks for a swell magazine, and special thanks to Gus for saving me a repair bill and a possible fine.—J. W. C., Drexel Hill, Pa.

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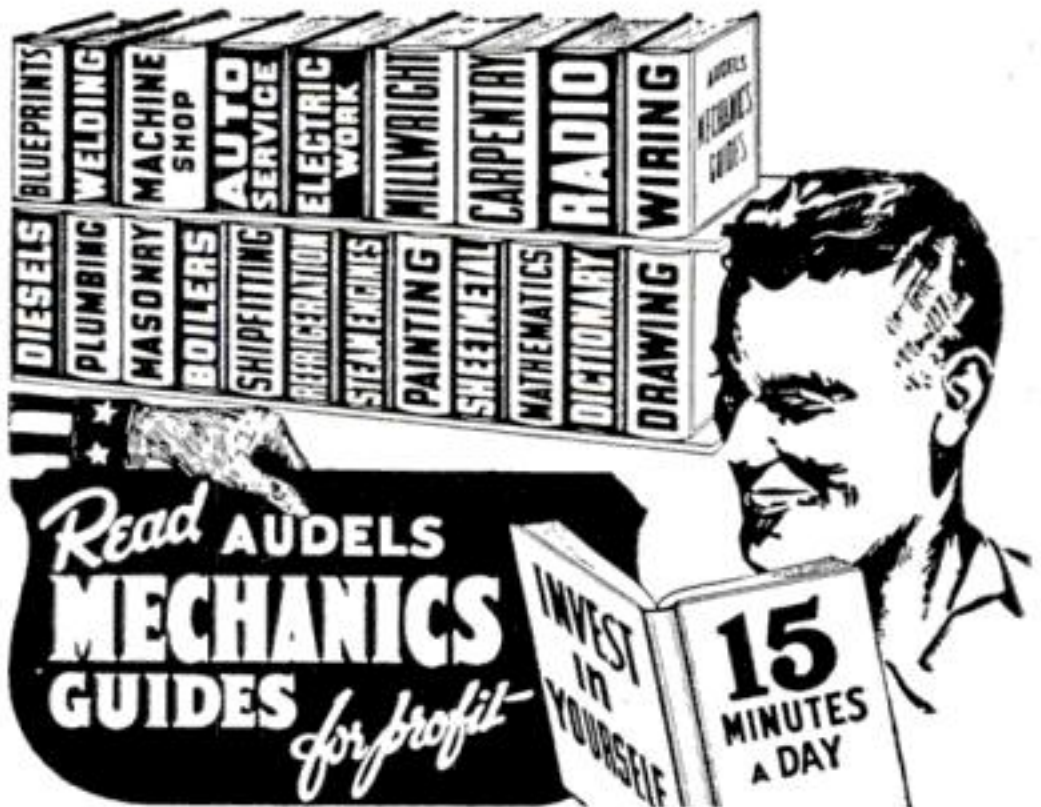
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I operate a business and do considerable work in a machine shop, where I would be lost without the extension pliers to obtain tools and parts out of my reach and to pick up items of various kinds off the floor. During World War II, our shop has been turning out parts for aircraft engines, and I have depended on this tool to help me overcome my physical handicap. It is definitely not a lazy tongs, but a decided asset in my shop.

Not being able to find them in stores, I have made extension pliers both for myself and for other shop men. I have used heavier tools of this kind to extract castings from a die-casting machine and to lift a crucible from a furnace or heat-treating oven. Perhaps the heavier tool should be called "extension tongs."—L. T. H., Lawrence, Kan.



How to Remove a Rock Ledge from Your Driveway

SOME time ago a reader requested a method for removing a ledge of hard rock that blocked his driveway. I have not seen a solution of his problem appear in your magazine since, so I submit the following suggestions, which I hope will be helpful. Build a hot wood fire on top of the ledge, and allow it to heat the rock to a considerable degree. Haul off the coals and throw a bucket of water on top of the ledge, which will crack up into slabs that can easily be picked off. I used this method on an engineering project in Vermont many years ago, and it worked very well. The sudden uneven expansion and contraction did the work.—R. K. C., Detroit, Mich.

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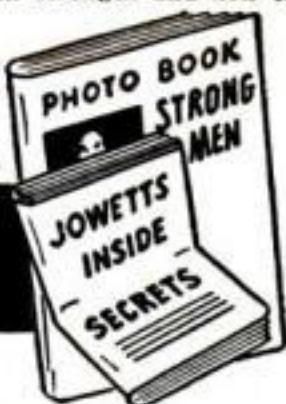
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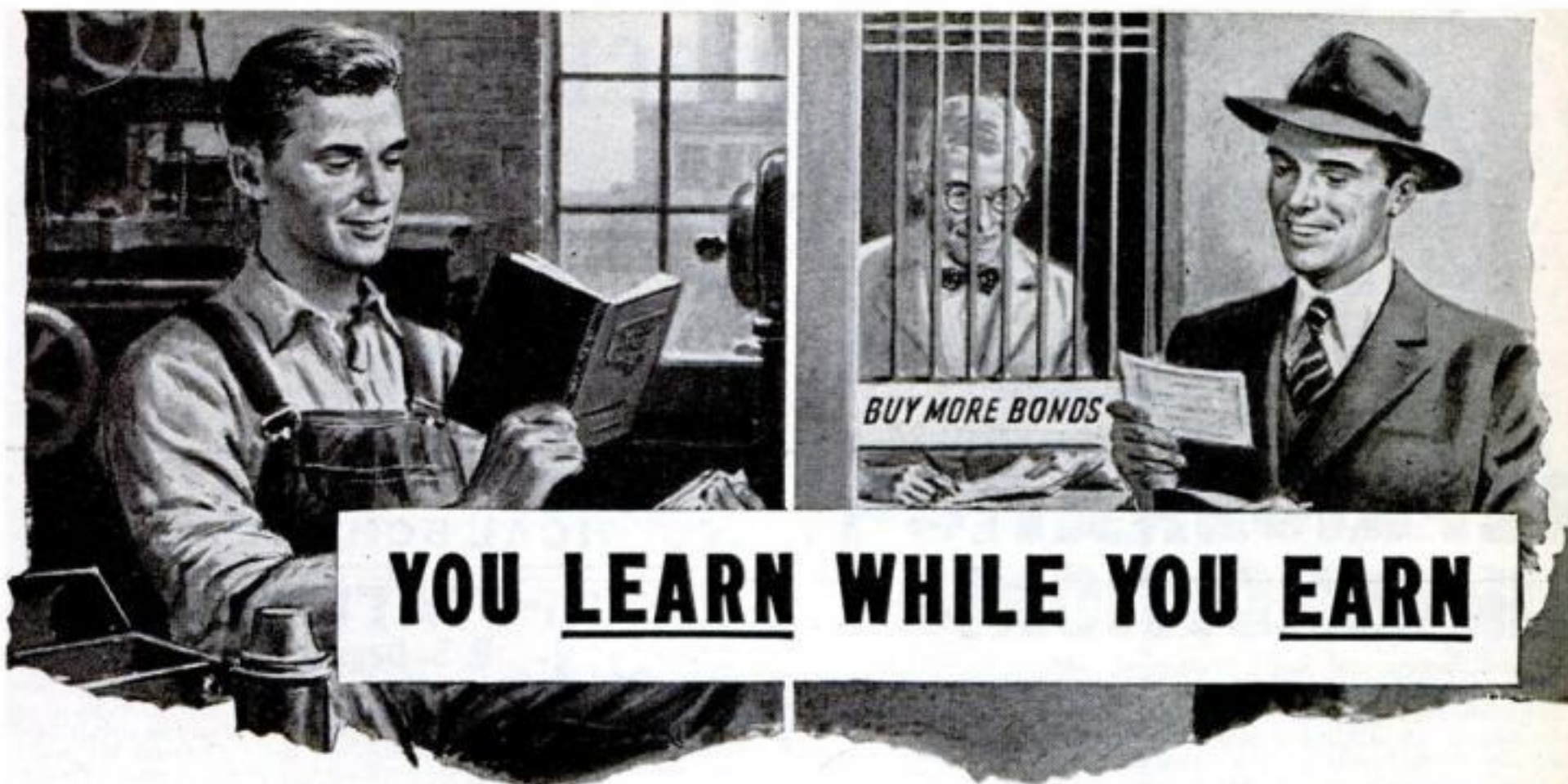
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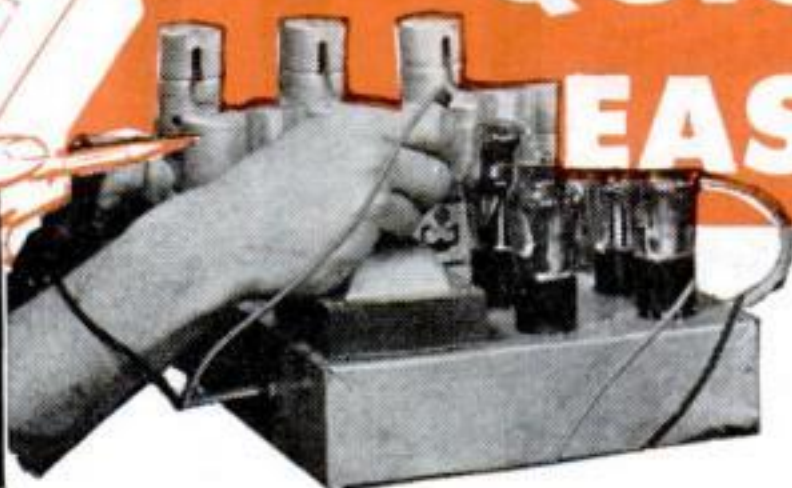
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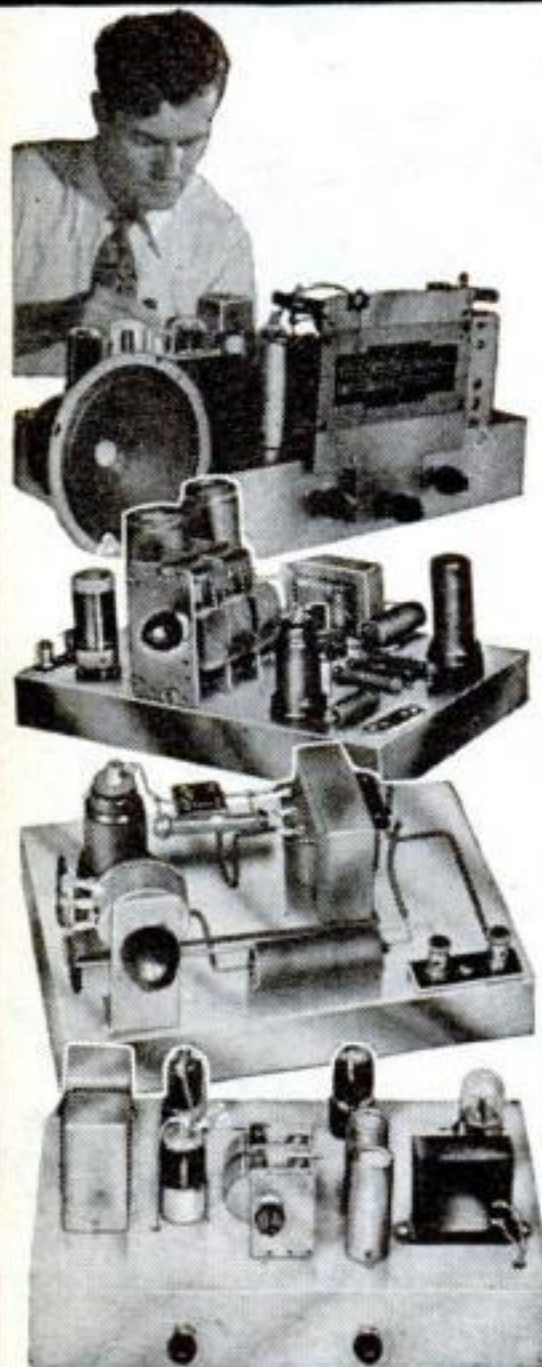
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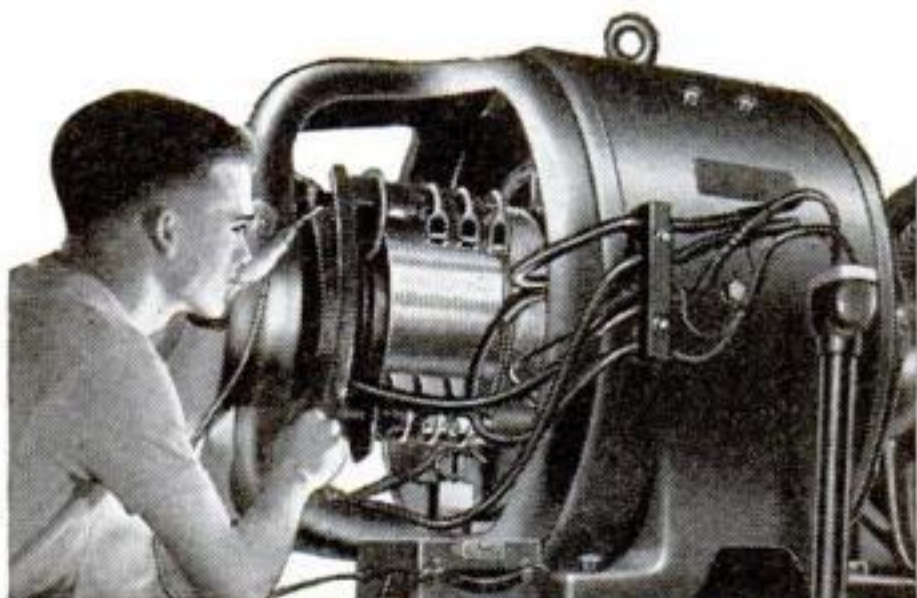
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"WELL, I guess I'm the fellow to see, for I've repaired thousands of refrigerators (home and commercial both), vacuum cleaners, radios, washing machines, irons, fans, lamps, mangles, motors, etc. In fact, many of my customers call me their "electrical appliance doctor." And, "doctoring," I might add has paid me a good substantial income for quite a few years. Funny, in a way, how I got started. Always liked to tinker and by experimenting around I found that most electrical appliances had many things in common. That, regardless of what the appliance was used for, or who the manufacturer was, the basic principles were much the same. From fixing my own appliances to fixing friends' and then for strangers at a fee, seems now to have been but a small step.

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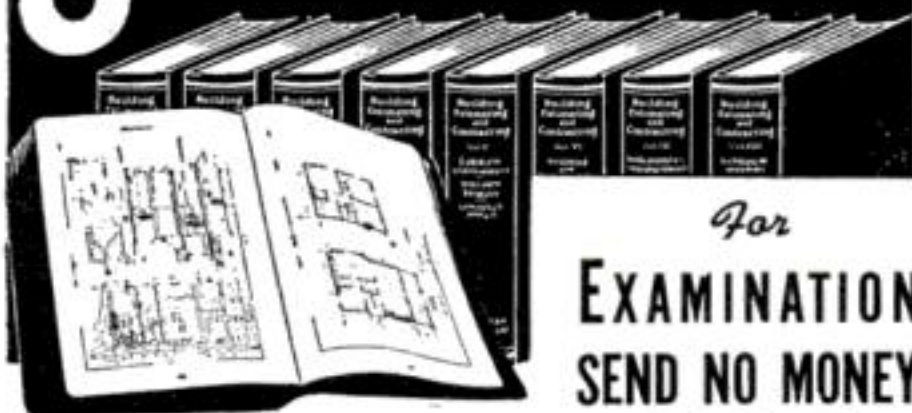
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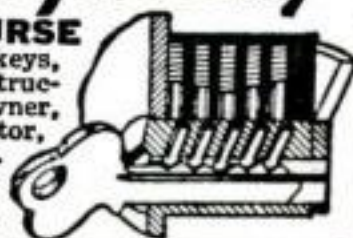


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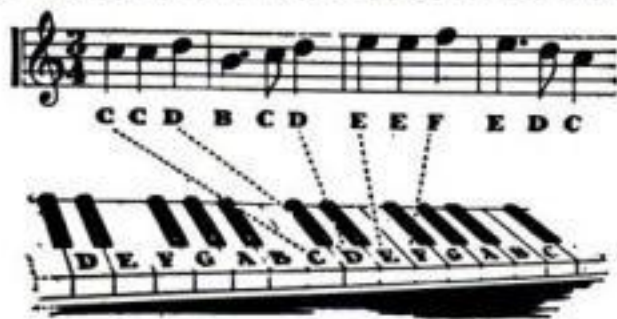
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It tells just how we do things—all our short-cuts, ideas, labor-saving methods—how it takes us only an hour or so of spare time a day to have tender chicken to eat, plenty of really fresh eggs, a wonderful garden, delicious rabbit meat, rich milk, butter, cream from our miniature dairy, tasty ham, pork, bacon, sausage, geese, turkeys, squab, spring lamb, honey bees, fruit trees instead of shade trees, luscious grapes, raspberries, strawberries, etc.—how we use the latest, easiest preserving methods, including quick freezing. (Note: no one family should start all these projects at once. But we describe them all so you can take your pick.)

No "Magic" About It

Now please don't get me wrong. This is no "crack-pot theory" on how to make an easy living. I suppose that if you absolutely had to, you could live a long time entirely off a small place like our two acres. But that would be just existing, not really living.

You've got to have some cash income—from a job or a pension or something. What I'm saying is that with my "Have-More" Plan you can make a small cash income into the best and happiest kind of a living any man could want. That's why we call it our "Have-More" Plan.

Furthermore, you and your wife have to be real partners and enjoy working together. If either of you think of the housework and the chores as just drudgery, you better go live in a boardinghouse or a two room apartment. Personally, we wish we could spend more time working around our place—it's so interesting.

Will You Join Us?

A friend said, the other day, "Ed, why do you bother with other people? Why don't you settle down and just enjoy your own job and your 'Have-More' Homestead? Why try to spread it all over the country?" I may sound silly trying to tell you why. This is my job now. I am putting full time into gathering information on country living . . . for ourselves and others. I feel, somehow, that in the years to come, the U. S. is going to need all the help it can get toward happiness and peace and security. We aren't always going to have a war boom going on. I've got a boy I want to see grow up in a good country, and if ten or twenty million American families can get set as well as the Robinson family is, I don't think anything can hurt this nation. Do you see what I mean? That's why I've worked so hard putting this Plan together. That's why I was so careful to be truthful and sensible in everything we put in it. And that's why I've kept the price as low as I possibly could—only \$1.00 postpaid.

Now It's Up To You

So if you are one of our kind of people, if you want to have a look at our "Have-More" Plan, just fill in the coupon here and send it to me. When you get the Plan—by return mail—look it over. If you are disappointed in it in any way or if it doesn't suit you, put it right back in the package and return it to me. I'll give you your dollar back and send you a dime for your postage.

On the other hand, if you like it, and I am sure you will, help me by showing it to your friends and getting them to start a "Have-More" Homestead also.

Yours for a "little land and a lot of living."

Ed Robinson
NOROTON 2809, CONN.

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YES, IT'S A SHAME TO THROW AWAY SUCH GORGEOUS PLUMAGE. I'M GOING TO WRITE TO THE N.W. SCHOOL OF TAXIDERMY AND LEARN TO MOUNT AND SAVE MY TROPHIES.

HELLO, BILL—SAY, THOSE SPECIMENS ACTUALLY LOOK ALIVE!

YES, RAY, IT'S THE GRAND-EST HOBBY IN THE WORLD. COME UP AND SEE MY DEN.

I'VE DOUBLED MY FUN FROM HUNTING AND FISHING—AND HAVE MADE \$84 ALREADY MOUNTING TROPHIES FOR OTHER HUNTERS.

AND YOU TANNED THIS FOX SCARF YOURSELF? BILL, YOUR DEN LOOKS GREAT. I'M GOING TO START LEARNING TAXIDERMY RIGHT NOW!

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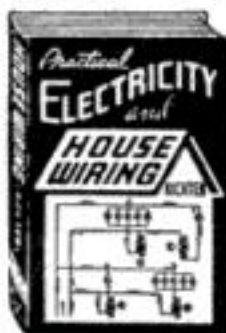
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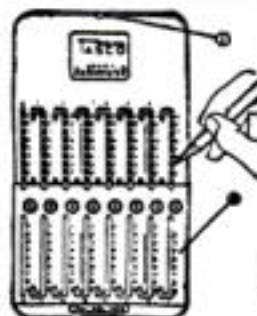
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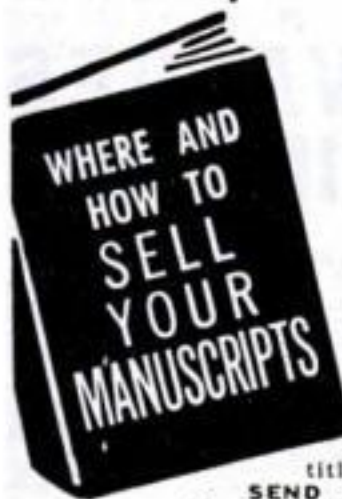
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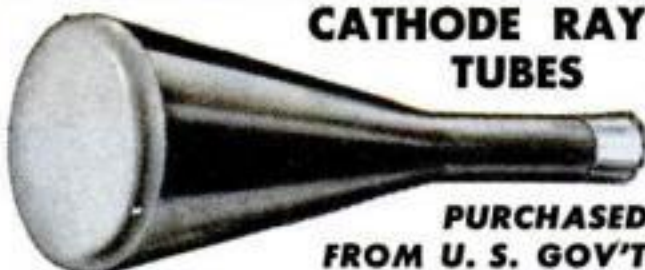
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IF you want to Swap Buy or Sell anything, send \$1 for The National Swappers Guide. It's chock full of Swappers Sellers and Buyers from coast to coast and opportunities to Swap Buy and Sell anything under the sun. National Swappers Guide, 610 St. Joseph, Evansville, 12, Indiana.

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GUARANTEED watch and clock re-pairing. 8-day service. Mail yours to, Rite-Time, 1318 W. 95th St., Dept. 2, Chicago, Illinois.

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SUPER Welder—For home, farm, factory. Makes even beginner an expert. Improved on type used by Navy. Fully equipped with Metallic Arc and Flame Torch Handles, Carbons, Rods, Fluxes, Mask, etc. Complete directions. Operates AC-DC, 110 Volts. No extra wiring needed. Guaranteed. \$19.95. Save 2% send check with order. Super Welder Mfg. Co., Dept. BN, 23 E. 20 St., New York.

NEW Model electric welder 110 volt AC-DC; will weld all metals; easy to use, full directions. Complete with power unit, flame and metallic arc attachments, carbons, fluxes, rods, mask; all for \$19.95—Used by the Navy. Magic Welder Mfg. Co., 239-PS-9 Canal St., New York City.

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Clasp your hands over the abdomen, as in the picture—then raise and press gently against it—and notice how much better you feel! Sturdy porous fabric is BUILT-IN with the special stretch weave of the Commander for EXTRA DOUBLE SUPPORT across the abdomen. Instantly the Commander flattens your 'corporation'—BRACES YOUR BACK—Improves your appearance—Your clothes fit smartly—You look better, too. No binding, no riding, no sagging! Send for this famous all-purpose supporter belt today!

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Send me The "Commander" for Free Trial. I will pay postman \$2.98 plus postage. (Sizes 28 to 47.) If not satisfied after wearing 10 days I may return it for a prompt refund. (Sizes 48 to 60 \$3.98.)

My waist Measure.....My Height.....

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We pay postage if \$2.98 is included

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Pay postman only \$1.98 C.O.D. plus few cents postage on arrival. If not delighted return in 10 days for full refund.

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• What a Compass this is! Made to give superior performance under any and all climatic conditions. Will not freeze at even 40 degrees below zero. Works perfectly under a blazing sun. Guides you accurately all hours of the day and night.

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GIANT TELESCOPE OFFER



BIG-POWERFUL OVER 3½ Feet Long!

The Yankee Clipper Super Telescope is by far the biggest, most powerful Telescope ever made to sell for only \$1.98 with Carrying Case included. It's guaranteed Super power and measures over 3½ feet in length from end to end. Lenses are of optically-ground polished glass. So powerful you can clearly see people and wild life miles away and watch what they're doing when they can't see you. Sensational! Exciting! Fun and adventure such as you've never known before.

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**Large
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☐ Enclosed find \$1.98. Please ship the Telescope with Carrying Case all postage charges prepaid.

FAMILY PLANE COST CUT IN HALF

Taylorcraft "Foursome" Already Flying!



BEFORE the war, 4-passenger airplanes were heavy, high-powered and costly. Prices were from \$7,500 to \$15,000 and more.

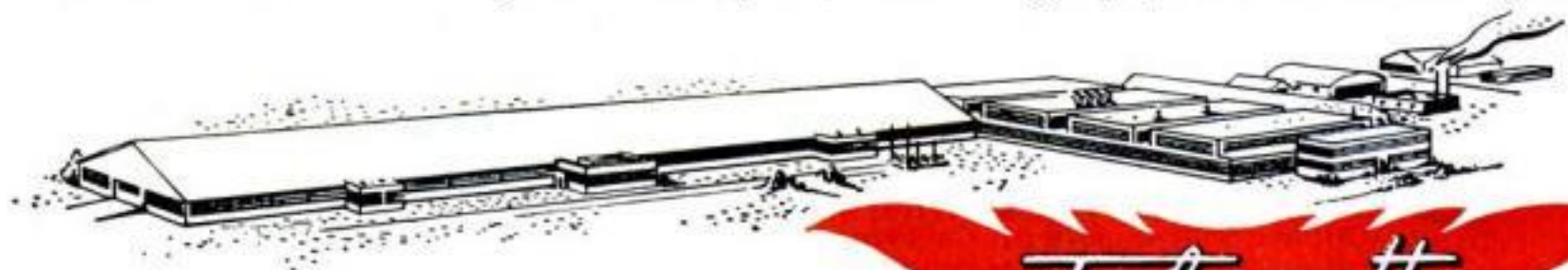
The new Taylorcraft "Foursome" takes the family plane out of this luxury price bracket for the first time in aviation history—yet provides luxury features never before obtainable in an airplane, regardless of price.

For instance: the biggest, roomiest cabin ever built into a 4-passenger plane. Electric starter—no prop spinning. Unlimited visibility—with wide windows all around and the new Taylorcraft one-piece

sunproof windshield. And performance *superior* to the heavy, costly prewar ships in many respects.

The instrument panel is compact and uncomplicated like the dashboard of your car, and the engine—what an engine! Light, powerful and smooth performing, it harnesses 125 horses—expert aeronautical engineers say it is the best all-around, most economical engine ever built for a 4-passenger plane.

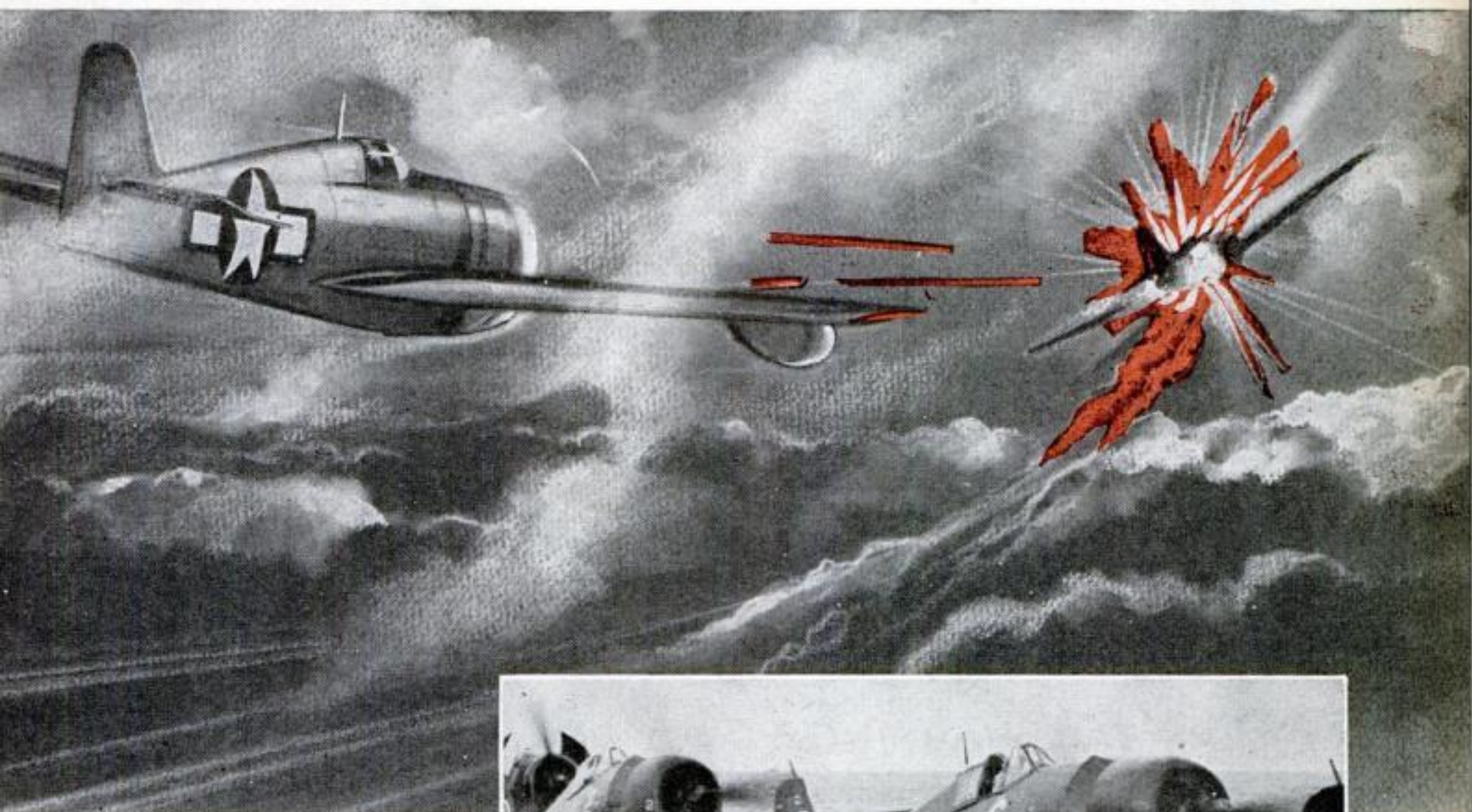
See your local Taylorcraft dealer. He will gladly give you full particulars and tell you how convenient budget payments can be arranged.



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How Fighters Shoot Down Planes They Can't See



RADAR DOES IT! In blinding fog, a Grumman Hellcat intercepts and destroys a Jap plane. At right, a night fighter of this type rests on a carrier deck. White-nosed nacelle near wing tip is one of the radar units that guide it unerringly to its quarry.



RADAR... Magic Eye **That Sees the Invisible**

**VEIL OF CENSORSHIP LIFTS TO REVEAL NEW SECRETS OF
THE VERSATILE WEAPON IN WHICH WE LEAD THE WORLD**

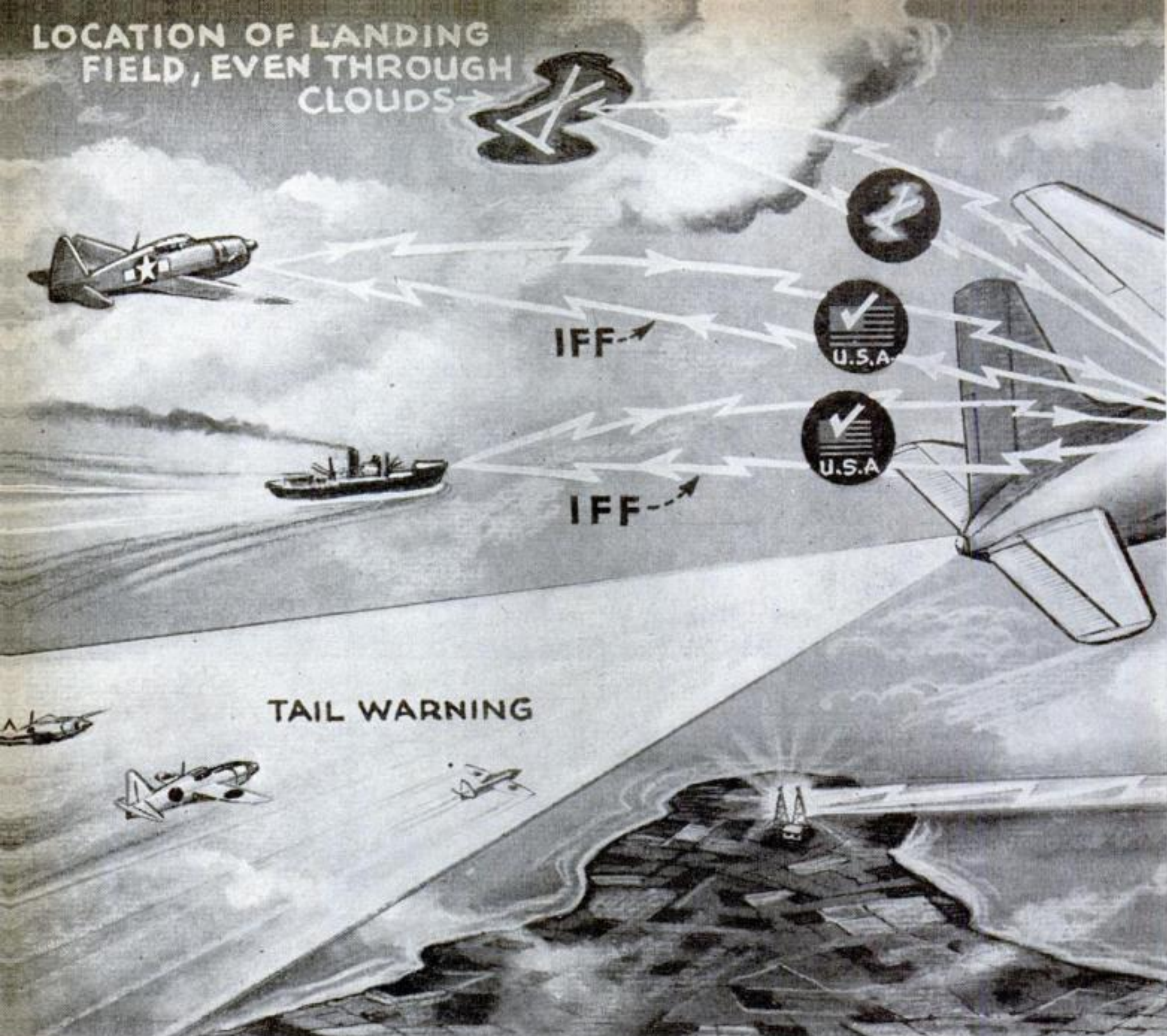
By **JAMES L. H. PECK**

Drawings by ERIC SLOANE

RADAR sees all, hears all, and tells all," an AAF pilot once remarked. "It has penetrated everything but the thick veil of secrecy behind which it has been screened." Now that the boys in the Pacific are even using radar to fish with in their spare time, its story has come crackling through censorship, too.

You've seen a searchlight throw a long, focused beam of light into the sky. It fades away into the darkness if it does not hit anything, but if the light strikes an airplane, some of it is reflected back to your eye. Suppose that this searchlight used radio waves instead of light; that it sent these waves out at rapid intervals; that it caught the waves whenever they hit an object and bounced back; and that it computed the distance they had traveled by

**LOCATION OF LANDING
FIELD, EVEN THROUGH
CLOUDS**



TAIL WARNING

SOME OF THE WAYS A BOMBER USES RADAR are shown in this imaginary view. While search radar combs the sky ahead, IFF (Identification of Friend or Foe) demands an automatic counter-sign from unknown planes and ships; a radar long-range navigation beam gives the pilot a bearing for finding his position; another device slices through fog or clouds to reveal a target or a landing field; tail-warning beam scans a cone astern to detect hostile planes beyond the range of vision.

noting how long the round trip took them. That's the essence of radar (Radio Detection And Ranging).

The radar operator (RO) on the ground at a fighter-control station on Okinawa announces the detection of an approaching Jap bomber by radioing one word to a Black Widow's crew: "Trade." He then tells the men in the night fighter 65 miles away the direction and distance of their foe: "Climb to 11,000. Vector, 2-9-7. Range, 42 miles."

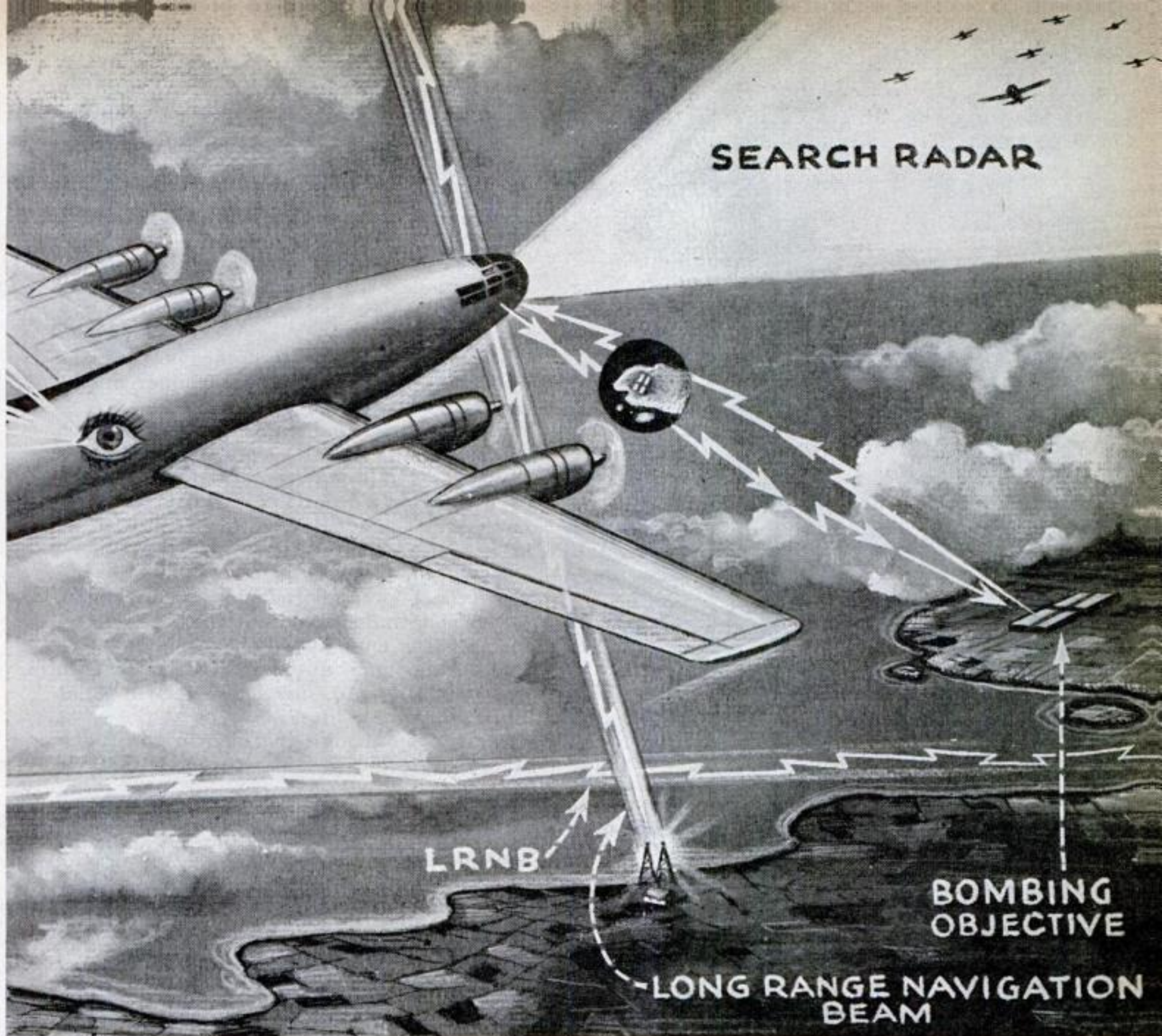
As the Black Widow banks around to a northwest course and surges forward at 350 miles per hour, the radar operator on the ground can note its progress as well as that of the Jap plane. At the same time,

another RO in the glassed-in rear of the Black Widow's fuselage adjusts his shorter-ranged, airborne-intercept (AI) radar set.

Invisible radio detection beams are thus shot at the Jap from both the ground station and the AAF night fighter. Officers on the ground chart the courses of the two aircraft on a tablelike plotting board; as the planes come closer together, another code word is radioed to the fighter: "Punch."

The gunner in the Black Widow, meanwhile, makes the adjustments necessary to enable the fighter's radar apparatus to aim and fire its turret machine guns at the enemy.

"Pilot from radar," says the RO in the

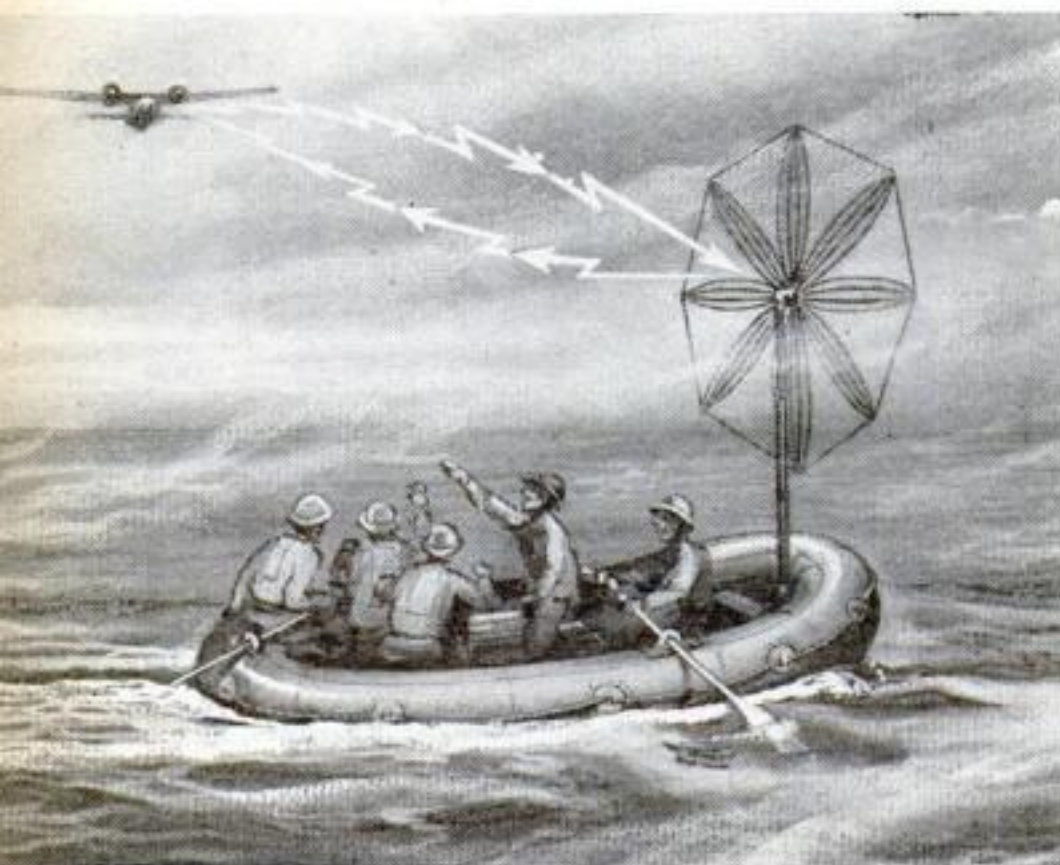


A Privateer (Navy patrol-bomber version of the B-24 Liberator) displays a load of radar gadgets. On top of the fuselage, back of the gun turret, is the IFF antenna. Under the belly, the second white "radome" is the "potato masher" for jamming enemy radar. The rounded bowl is the retractable "dish" antenna of the ASV (Air to Surface Vessel) search set. Rods behind this are antennas of the radar altimeter.



SMALL RADAR BEACONS can be planted near important targets in enemy territory by paratroopers or commandos. All that our bombers have to do is to "home" on the signals, which guide them to the spot and direct their bombing through overcast. The automatic beacon may even be dropped alone on a parachute by a fast fighter.

RADAR SAVES LIVES of ditched airmen. Life rafts are now equipped with "corner reflectors"—flower-shaped antennas that are set up to throw back the pulses from transmitters of search planes. Reflected pulses create a distinctive pattern on the scope, guiding rescuers directly to the scene.



night fighter when he sees a "blip" of light on the screen of his radar that tells him the waves from his apparatus have begun to bounce back from the Jap. He speaks over the plane's intercom, "Target, 11 miles. Bearing, 20 degrees."

"Roger," says the pilot, and proceeds accordingly.

"Judy," sings the radar operator in the Black Widow to his colleague at fighter control on the ground; this means that the fighter has spotted the Jap bomber and is taking on the job of destroying it.

Now the RO in the Widow must watch the screens, or radar scopes, on his instrument panel to keep from losing the image of the target. There's a penalty for this; he will be demoted to ground duty if he loses a target three times. As the Widow closes in on the Jap in the darkness, he advises the pilot and gunner: "Dead ahead. Range, one mile. Mark, gunner."

That's the gunner's signal to flip a switch that brings the automatic airborne gun layer (AGL) into operation. It will sight and fire the four machine guns at the right instant, even though the men in the Black Widow have not seen the target with their eyes.

The roar of the two big engines is broken by two short bursts of fire from the .50 caliber guns, directed by the fighter's radar eyes. Flames reveal a Japanese Betty medium bomber, with a kamikaze, or baka bomb, snuggled beneath its belly. The Widow may swing around to let it have a few bursts of visually sighted fire from the four 20-millimeter cannons in her fuselage.

The result will be reported in one word, spoken into the microphone by the RO in the Widow and heard by the men on the ground: "Murder!"

That is how radar is used in Black Widows. The single-seater Corsair and Hellcat carrier fighters have a different kind of radar equipment (AIA instead of AI) which enables the pilot to do everything. The target appears on the radar scope of this apparatus as a large dot of light, and the pilot flies so as to keep that dot lined up in the center of his scope. The size of the dot that is the enemy plane tells him when he is within range.

The heart of radar is a cathode-ray tube, shaped like a trumpet, through which electrons are shot. These tiny negative charges of electricity we call electrons bombard and illuminate a fluorescent screen on the flared, wide end of the tube. Alterations in the current result in the formation of light patterns on the dimly glowing screen. The nature of these patterns, and the alterations in the electron stream that cause them, is determined by the very short

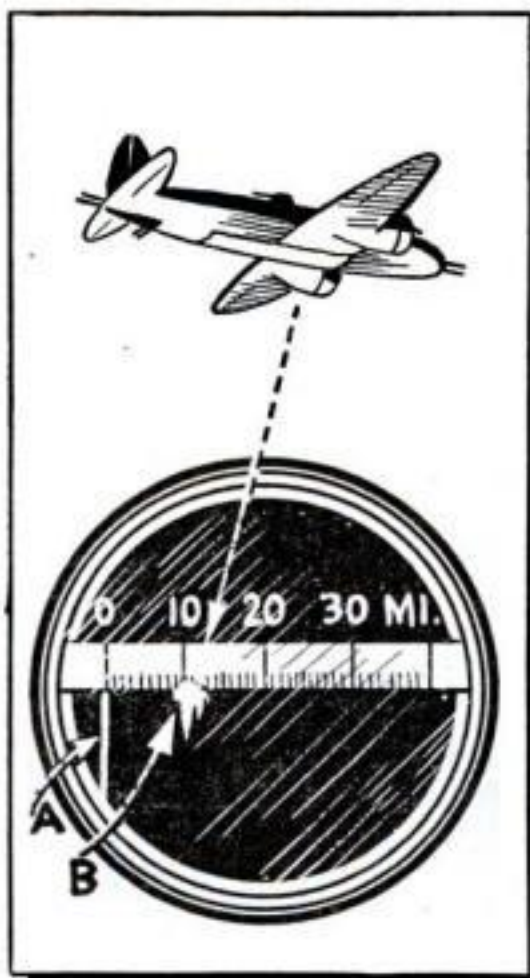
MEASURES FOR DEFENSE AGAINST RADAR

LIKE every other revolutionary new weapon, radar has been met with defensive measures. The most common of these are artificial reflecting agencies and "jamming" with other kinds of radio sets.

"Window"—strips of paper-backed tin foil—has been used effectively by both Allied and Axis planes. As shown in these drawings, it is scattered in the air to reflect radar impulses and blur the echo pattern.

Dropped early in a mission, "window" can thwart early - warning radar, making the operator overestimate the bombing force.

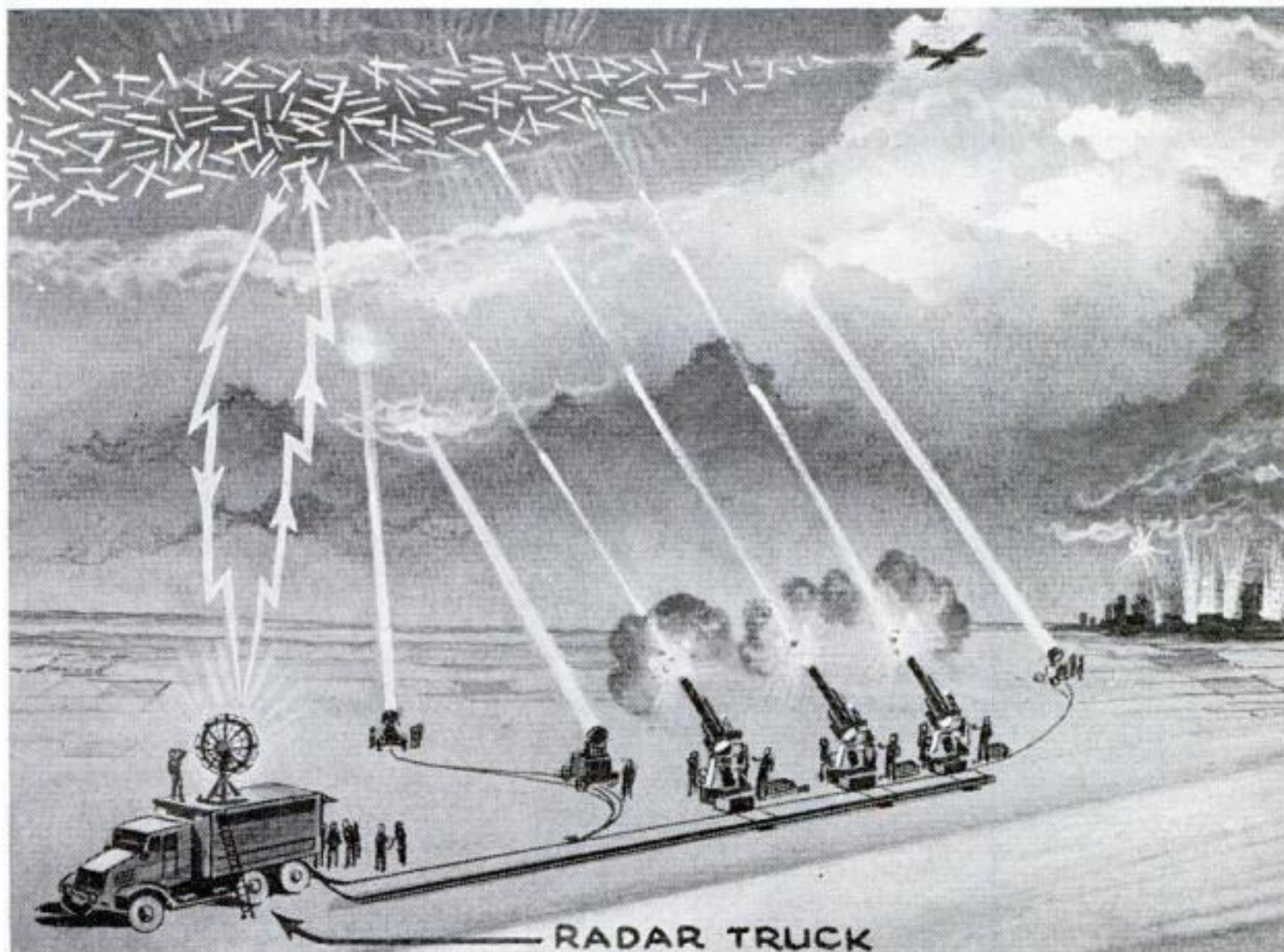
German "window," good only against microwave radar, was dull black. The Allied type is silvery, like tinsel.



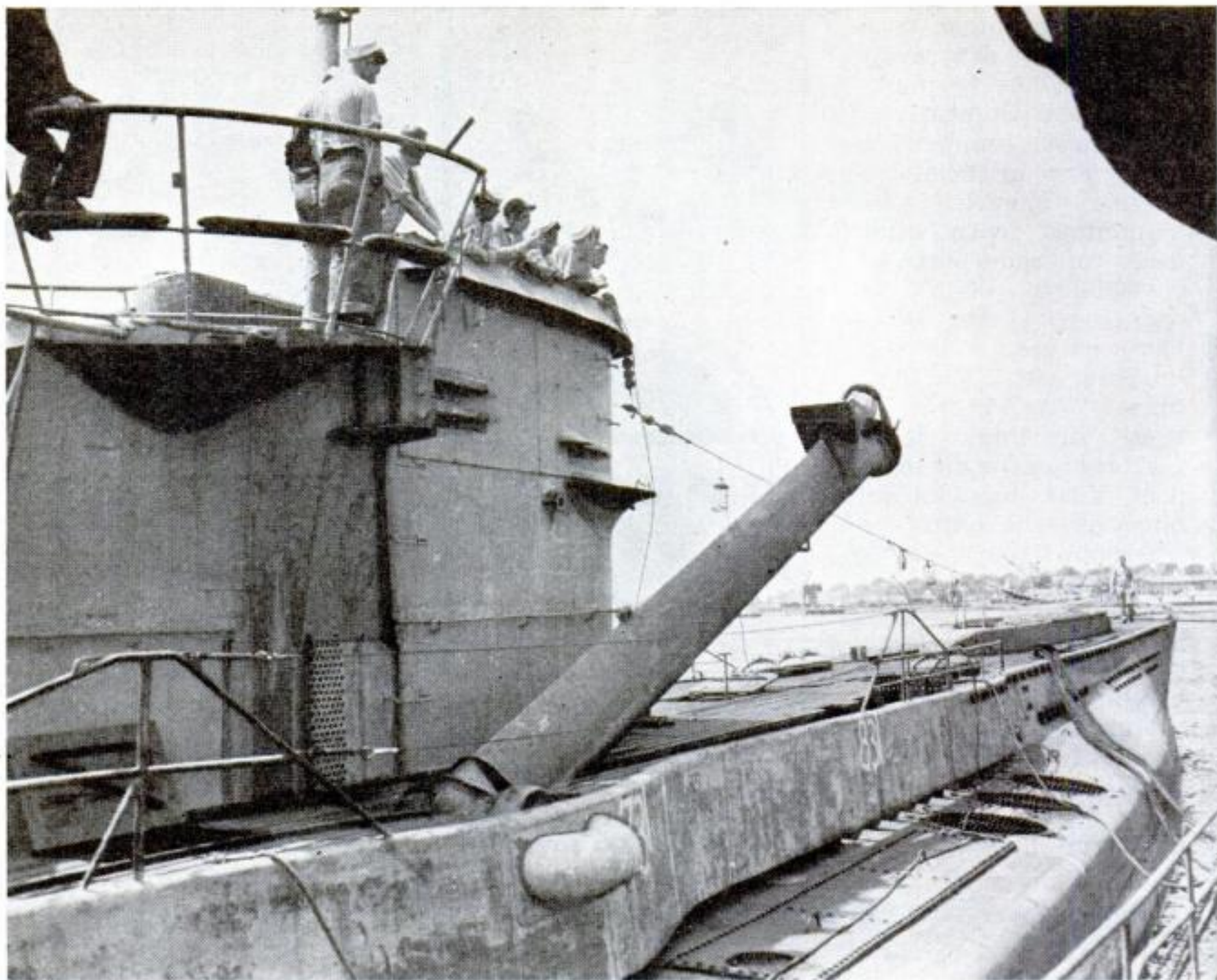
1 A ground radar station detects a plane by the echo, or "blip," (B) on the scope. Scale shows elapsed time, and therefore the range. The anti-aircraft guns then go to work.



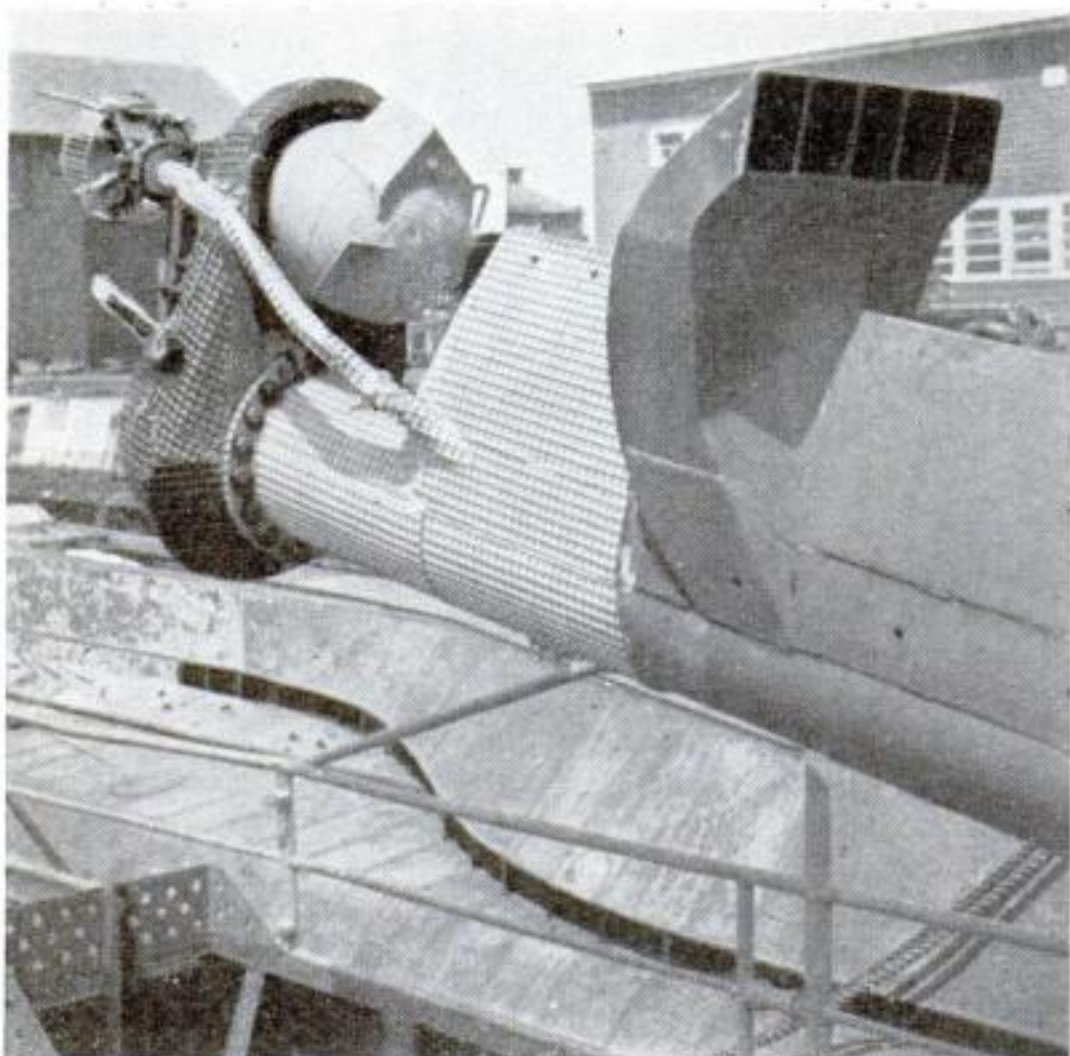
2 Scraps of tin foil are scattered by planes to blur the radar echoes, producing a hazy pattern that makes range-finding impossible. This device is used by both Allies and enemy.



3 The plane makes its escape as radar-controlled anti-aircraft guns are thrown off their aim. The strawlike strips of paper-backed tin foil are called "window" because, as one British radar sergeant-operator put it, "It makes a window in your scope so big that Jerry flies right through it."



Radar detection made it so hot for enemy submarines that the Germans adopted the "schnorchel" (breather) for charging batteries while submerged. Here is one on a captured U-boat. It folds when not in use.



The German sub carried radar of its own, for spotting Allied ships and planes. Equipment was mounted on the schnorchel.

radio waves that bounce back from the detected object.

Since the speed of these pulses is the same as the speed of light—which can flash the 186 miles from New York to Baltimore in one thousandth of a second—the time it takes the waves to go from the transmitter antenna to a distant object and back to the cathode tube is extremely brief, but it is measurable. This measurement gives the distance, or range, of the target. The direction, or bearing, of the located object is revealed by the direction in which the radar antenna is aimed. Several types of antennas are used.

The Japs do not seem to have the laboratories and the materials to put their radar equipment on a par with American sets. Their present warning and fire-control devices compare only with early 1942 American radar. Their airborne equipment appears to be

even less efficient. However, they are making intelligent use of what they have.

The Germans, too, got off to a late start in radar development; but, when V-E Day arrived, their warning and fire-control apparatus was nearly as good as ours. The Luftwaffe did not employ airborne sets as widely as did the Allies.

The British led in the development of what they then called "radio-location." They introduced many of the present applications, such as navigation and bombing through the overcast. But their devices had many limitations, which were overcome largely by American scientists and Army and Navy technicians. Although most of our radar experimentation has been carried out as a joint operation, U. S. experts have made more rapid improvements, and more of them. Today, we are farther advanced than any other nation, thanks also to industrial plants such as RCA, Bell, General Electric, Western Electric, Westinghouse, and Philco—to name only a few.

Amazing strides have been made since we used the long-wave, broadcast-frequency types at Pearl Harbor, where Private Joseph Lockhard (officially off duty) detected the unidentified planes that turned out to be Japanese. This long-wave equipment was

also used during the epic Battle of Britain, and is credited—along with the RAF—with saving England. The long broadcast waves provided good range and a wide coverage of the sky. However, the very nature of these radio waves that permitted RO's to scan wide sectors resulted in the formation of blind spots, particularly close to the ground.

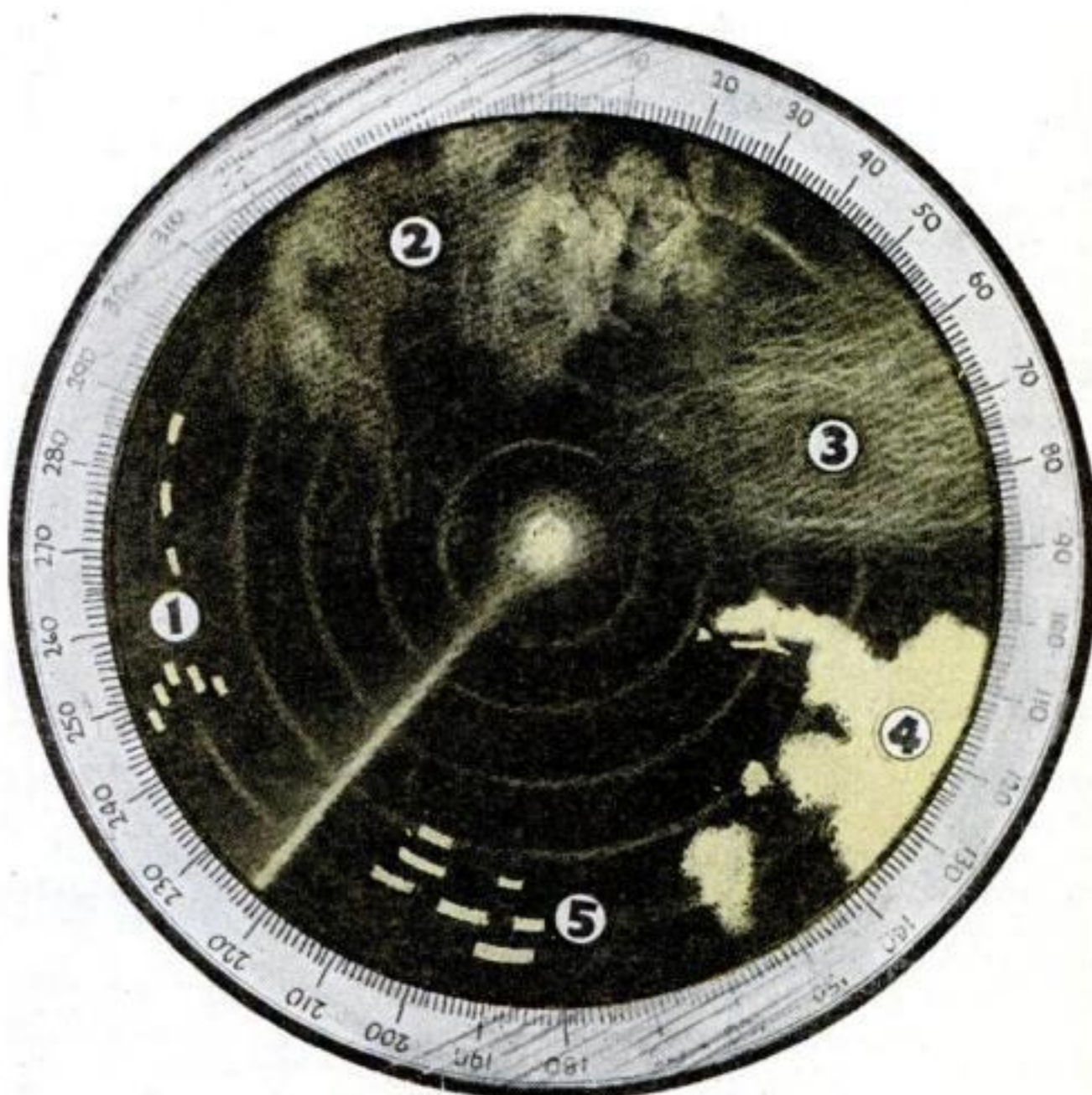
Much of the newer equipment, brought into use since 1942, is of the microwave type. These extremely short waves—measured in terms of megacycles and centimeters, instead of kilocycles as in your radio—do not scatter like broadcast transmissions and have a much better bouncing quality, or "mirror effect." The combination of long- and short-wave radar has been used with great effectiveness. The microwave apparatus covers the blind spots left by the long-wave sets. The latter, like a widely focused searchlight, is effective for finding the target; but the microwave equipment is used to better advantage, like a higher-powered, narrower-beamed spotlight, to put the finger on the enemy after he is first detected.

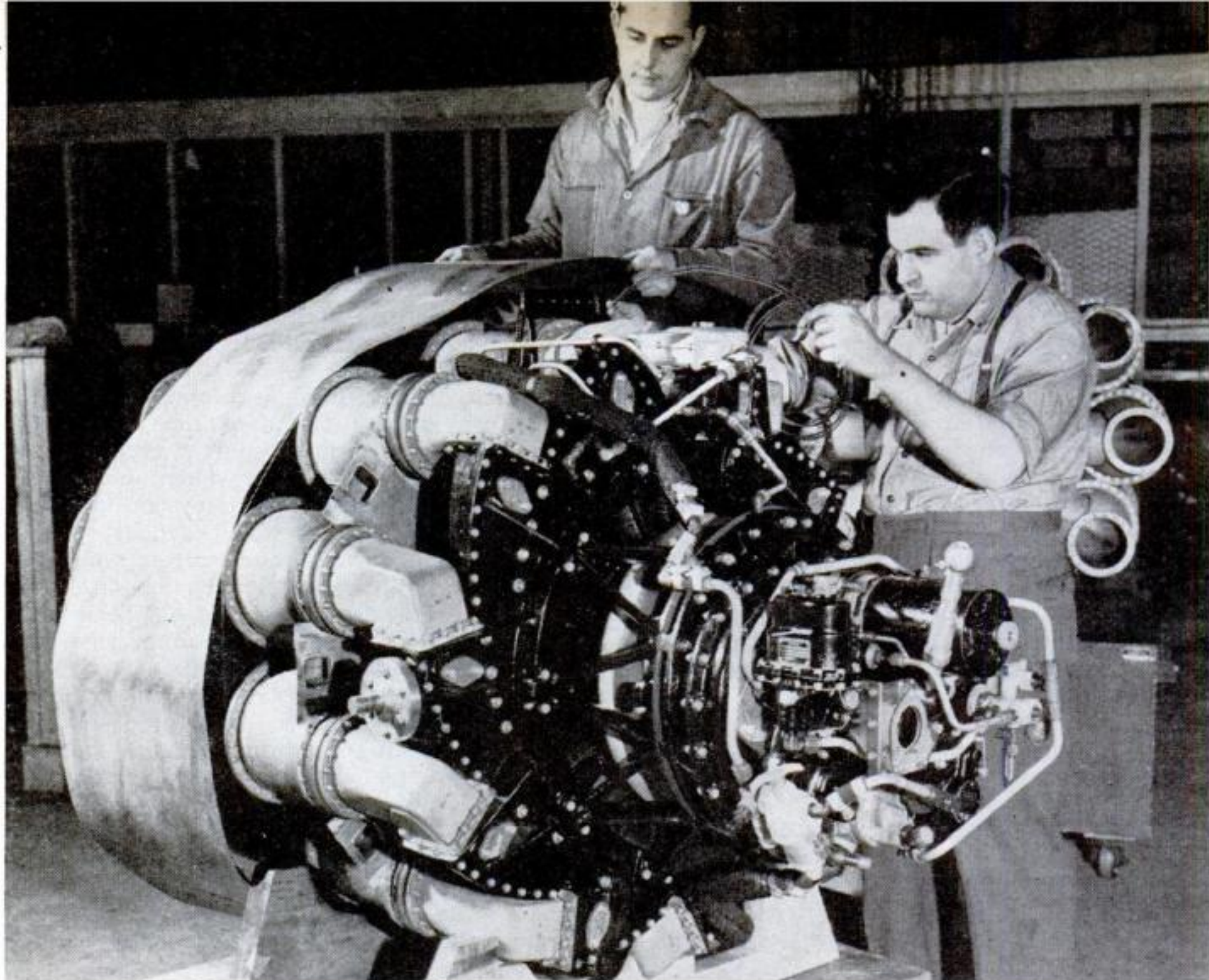
Such detection was the first use to which radar was put; it was purely a device with which the enemy *(Continued on page 210)*

SEE IF YOU CAN READ THIS RADAR SCOPE

This is the viewing scope of the PPI (Plan Position Indicator). It shows the area below; center dot is plane's position. Numbers on rim give bearing; concentric circles, range. Water areas appear dark, land areas light. The luminous arm sweeps over the area.

- 1 A flight of planes. It may be identified as friendly or hostile by radar challenge (IFF).
- 2 Frontal clouds. Radar also tells the weather lying ahead of plane.
- 3 "Sea return"—echo of radar waves from rough sea—is interference.
- 4 Promontory and islands. Any shore installations?
- 5 Task force of warships. Search planes report their size and course.





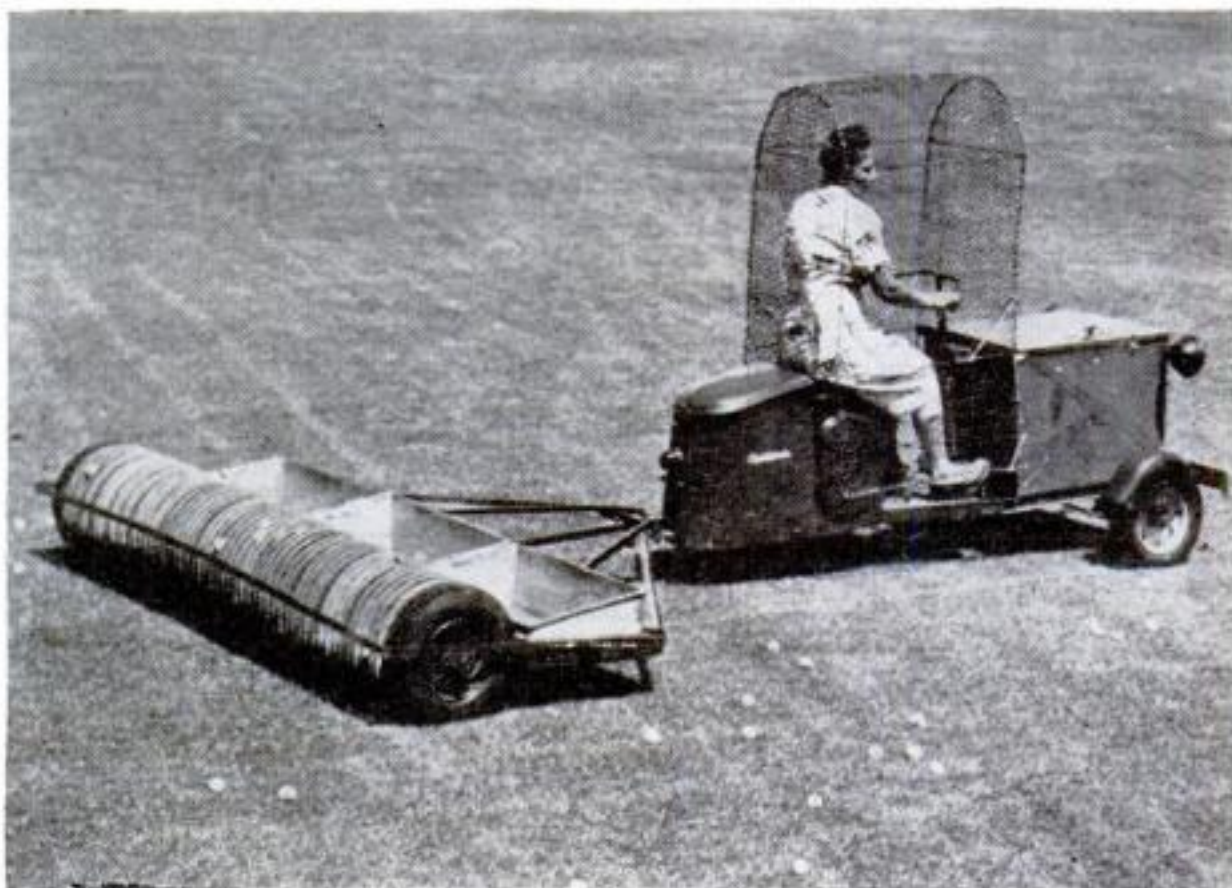
Here's What Makes Our Jet Planes the World's Fastest Fighters

WE HAVE been reading and hearing a lot about the spectacular jet plane, but here is the first picture of a jet's power plant to be released for publication. Two of these General Electric engines propel the P-59A Airacomet, while a somewhat similar Super G-E Jet drives the P-80 Shooting Star.

Just inside the front cover shield, at the left, is a compressor, which whips air to combustion chambers. There fuel, usually kerosene, burns fiercely, increasing the velocity of the air and hot gases that pass through a turbine wheel and on out by way of the jet exhaust.

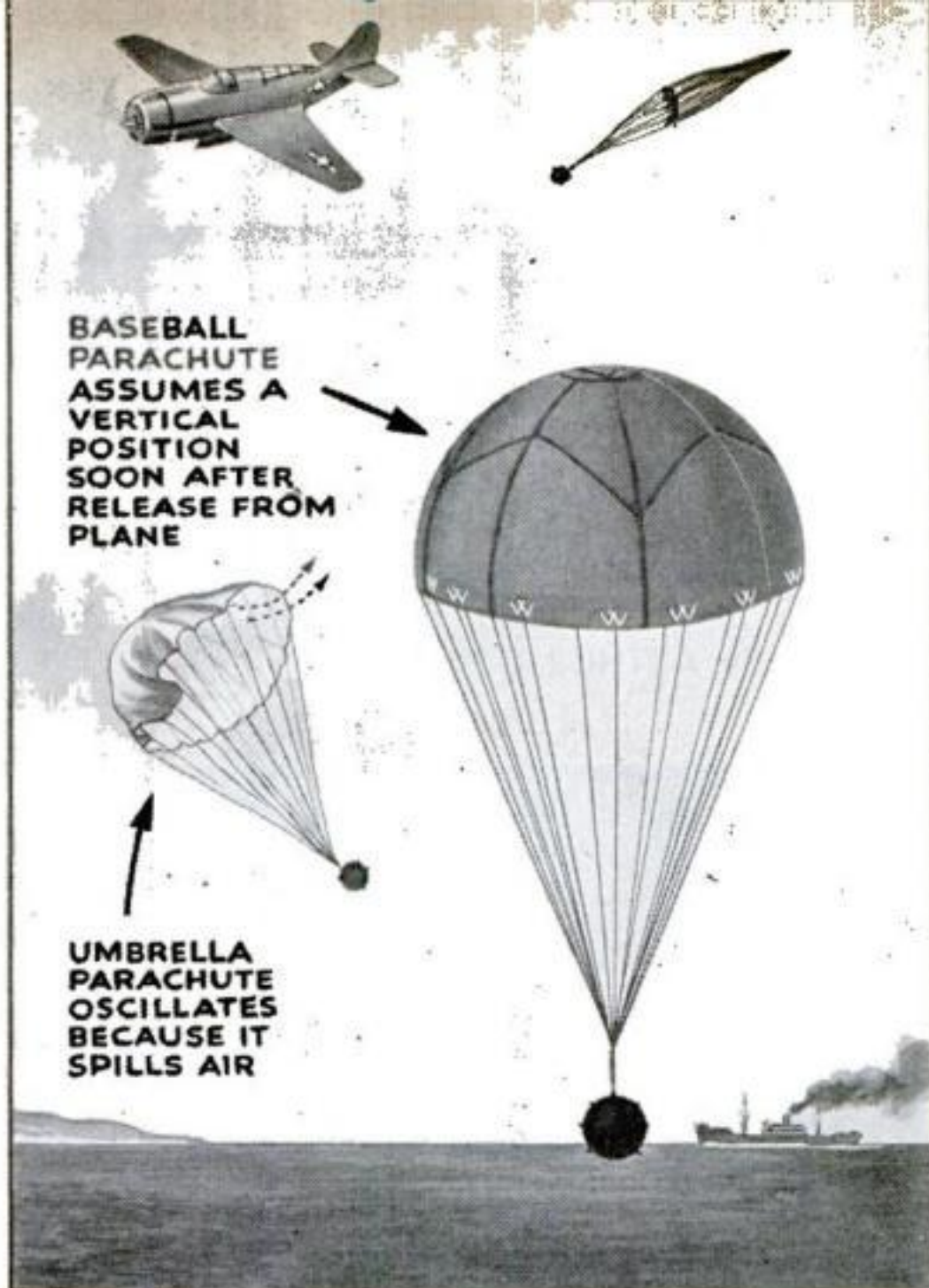
Golf-Ball Picker-Upper Retrieves Pellets and Protects Its Operator

HERE'S a golf-ball retriever that does its job on a practice driving range even while a shower of the white pellets is falling. Towed by a motor scooter, the contraption has 52 wooden disks which turn on an axle as the machine rolls over the fairway. The balls become wedged between the disks and are carried forward. Steel fingers at the front end then knock them into a metal tray. Jerry Claps, of Newark, N. J., is the inventor; his wife, under the screen, the operator.



"Baseball" Parachutes Don't Wobble Coming Down

A NEW-TYPE parachute, named "baseball" because of its similarity to half of a baseball cover, has the advantage of greater directional accuracy. The conventional parachute, launched from a fast moving plane, leaves almost parallel to the earth. As it opens, it spills air from its upper edge, causing the 'chute to swing in the opposite direction, again spilling air. This is repeated all the way down. A jumper can control this oscillation to some extent by pulling the lines on the side that spills air. The baseball parachute holds most of this air because of its hemispherical shape, thereby eliminating most of the sway. It was developed by Leonard P. Frieder, president of General Textile Mills, New York, and Walter Finken, chief engineer. The design can be used for both cargo and personnel 'chutes.



Biggest Helicopter Carries Crew of Two and 10 Passengers

THE PV-3, first helicopter designed for air-transport operations, is also the first successful one to use two rotors in tandem. The fuselage is 48 feet long and 13 feet high, and houses the Continental-Wright

R-975 engine aft of the cabin. The PV-3 can land in a 100-foot-diameter clearing on land or water. It was designed for Coast Guard and Navy air-sea rescue and transport-service requirements.



U. S. Infantry Fights

Lightweight vests of nylon and thin metallic plates save GI's from Japanese shell fragments.

By ARTHUR GRAHAME

BODY armor is reducing the number of casualties among the American infantrymen storming into the heart of the Jap homeland.

Like the knight of the Middle Ages, the GI is protected against the lance of battle—in modern war, the shell fragment. The armor is light and compact. It can be shed

Photographs by
WILLIAM W. MORRIS
and HUBERT LUCKETT



FRONT view of U. S. infantryman's body armor shows the 12-pound vest that protects front and back, and the detachable 1½-pound apron. They stop shell fragments causing most wounds.

BACK is shielded down to the waist. The panel at the shoulders unfastens at the top for folding; lower part of back has same protection built into it.



in Aluminum Armor

in a twinkling and packed away in his kit. Except under the most strenuous battle conditions, when ease of movement is paramount, it is worn with comfort.

The adoption of body armor by the Infantry, just announced by the Ordnance Department, means two things: fewer and less serious wounds, and fewer replacements of troops on the battlefield.

Eight percent of all battlefield casualties, and half the deaths, are caused by shell fragments (sometimes erroneously called shrapnel). When the bursting charge of a high-explosive shell detonates, the steel projectile is shattered into thousands of fragments which are thrown unevenly over an area proportionate to the size of the shell. These fragments vary widely in size and shape. Some are dustlike particles of steel; others are jagged slivers weighing a small fraction of an ounce; comparatively few are larger chunks of metal. They are projected from the bursting shell at a speed of about 3,000 feet a second, but they lose velocity

quickly and seldom are traveling over 1,500 feet a second when they strike. No body armor light enough for a soldier to wear can protect him against a direct hit by a high-explosive projectile, or even from sizable fragments from a burst close to him, but the body armor being supplied to our men can and does protect them against a large majority of fragments.

The GI's armor is designed specifically to stop most shell fragments from penetrating the skin. Most wounds occur in the torso. That's the area the armor protects.

Body armor is not new in this war. Bomber crews have been using it in the form of "flak suits." These are easy to wear because a man in a bomber doesn't move around much. Armor for the warrior with only his own feet for mobility is something else again. It has to be light. It has to leave his movements unrestricted. It has to be styled so that it can be doffed instantly in an emergency.

Army Ordnance produced just that kind

FIT is assured by two sets of snap fasteners on each shoulder strap. This makes it possible for one size to suit all wearers.

CARRYING. The new body armor can be folded compactly, placed in its kit bag, and carried in a pack. In this way, it is ready for use when combat conditions call for it.

JETTISONING is easy whenever the armor becomes a hindrance, as in strenuous combat. All the GI has to do is to give a yank to each of the shoulder straps, step out of armor.

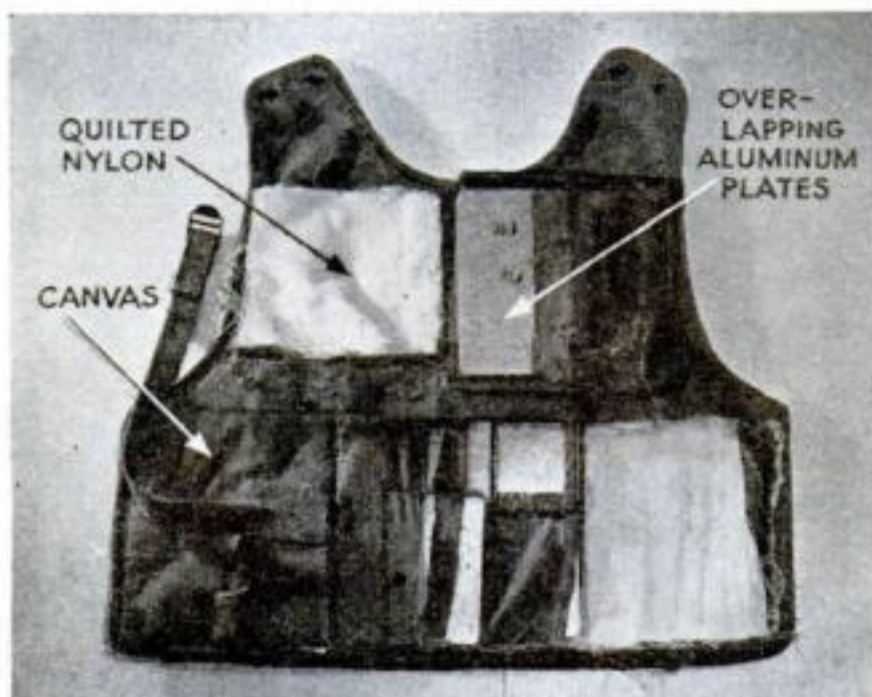




PENETRATION of this vest front by fragments of steel is shown by the holes indicated. Pieces that pass through the three- by five-inch aluminum-alloy plates inside are further slowed by nylon pads.



This back piece took a lot of punishment. Our body armor can't stop all shell fragments, but it protects against the kinds that cause most casualties.



HOW IT'S MADE. Under the cover of the vest are overlapping plates of aluminum alloy, backed by pads of quilted nylon. The flexible apron (not shown) contains no metal but gives good protection.

of armor. Ordnance went further. By a series of painstaking tests it determined how much velocity the little pieces of metal plate, backed by quilted pads of multiple-layer nylon, would stop. While the infantryman's armor is considerably lighter than that in a flak suit, it is similar in design.

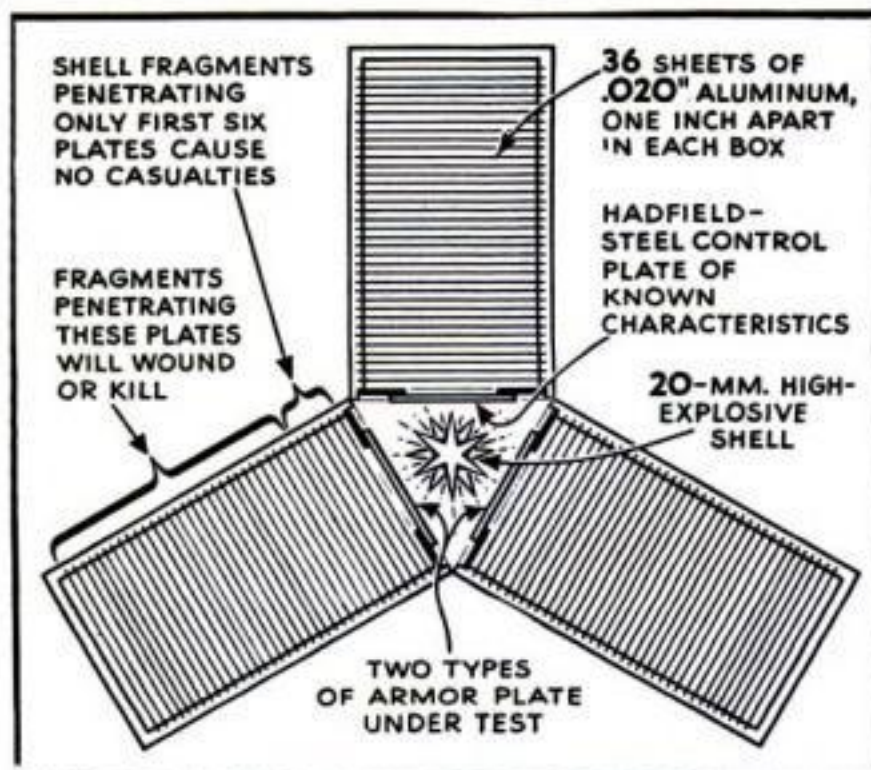
It is a vest weighing 12 pounds that affords protection for both the front and the back of the soldier. The vest consists of aluminum-alloy plates measuring three by five inches—lighter than manganese steel but equally resistant—backed by the nylon pads. Shell fragments that penetrate the plates either are stopped or their velocity is greatly retarded by the nylon fibers. Hit a pillow with your fist. Feel it yield reluctantly. That's what happens when a shell fragment penetrates the armor metal and hits the fabric.

To the vest is attached a small, flexible apron, weighing only a pound and a half and also made of quilted nylon, that protects the lower half of the abdomen.

A jerk on two shoulder straps instantly jettisons both pieces. Vest and apron may be folded compactly and carried in a pack. A man jumping from a foxhole and legging it across terrain under fire doesn't want to be encumbered. But a man standing in a landing barge and preparing to hit the beach, and even one crossing a beach under a hail of bullets and artillery shell fragments, finds his body armor the shield and buckler of modern war.

In the development of infantry armor,

TESTING of body-armor plate is done at Aberdeen Proving Ground with the arrangement of steel boxes pictured below. A 20-mm. high-explosive shell hurls fragments against the test plates and the standard control plate. Protective quality of a plate is gauged by the number of aluminum sheets behind it that the fragments penetrate after piercing it.



Ordnance went directly to the experience tables of the Air Forces for information. The Eighth Air Force made the first attempts to protect its flyers against the fragments of flak bursts in 1943 when strategic bombing was being stepped up in the face of determined opposition by German fighters (armed with cannon as well as machine guns) and antiaircraft batteries. Casualties among bomber crews were becoming serious.

A type of body armor had been developed for infantrymen in World War I but it was too heavy to permit a man to move as fast as he had to in combat. The Eighth Air Force modified one of the 25-year-old suits and placed orders for a limited quantity. They worked. Casualties dropped 60 percent.

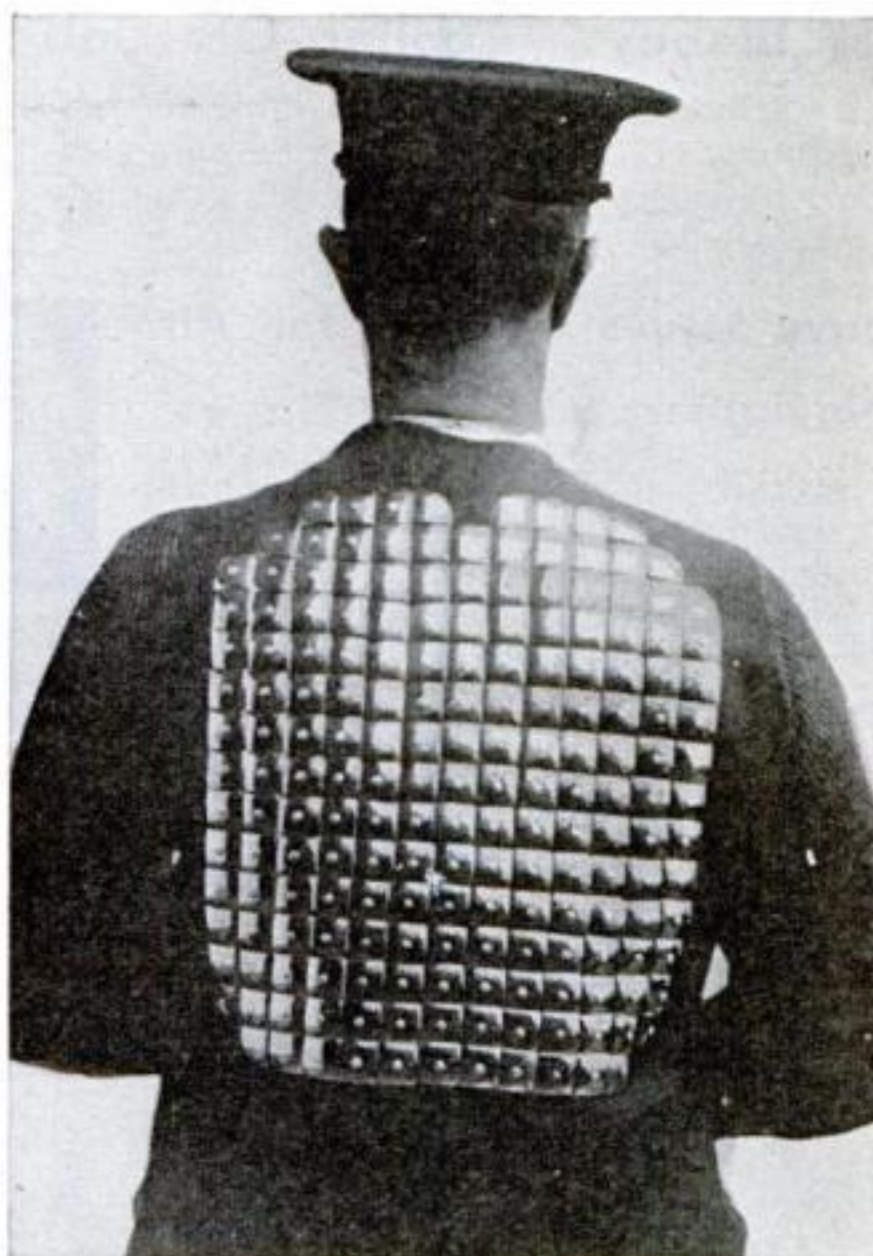
Then samples were sent home to Ordnance. Col. Rene R. Studler, chief of the Small Arms Development Division, was given the job of improving the suit and getting it into quantity production. He found that while it often was saving its wearer from death and wounds, it did show a lot of holes from shell fragments. Colonel Studler pondered that one. Then he made a decision that was to have a profound effect on body-armor design. It was this: the number of holes produced could be disregarded. It was what the shell fragments did after they made the holes that was important.

Apparatus for testing body-armor material was devised and installed at Aberdeen Proving Ground, Maryland. From what was learned in detonating explosives statically an improved flak suit was constructed. It was only a step from a better flak suit to an infantryman's armor.

Pilot models for body armor, and for steel helmets as well, are made just where you would imagine they would be made—in

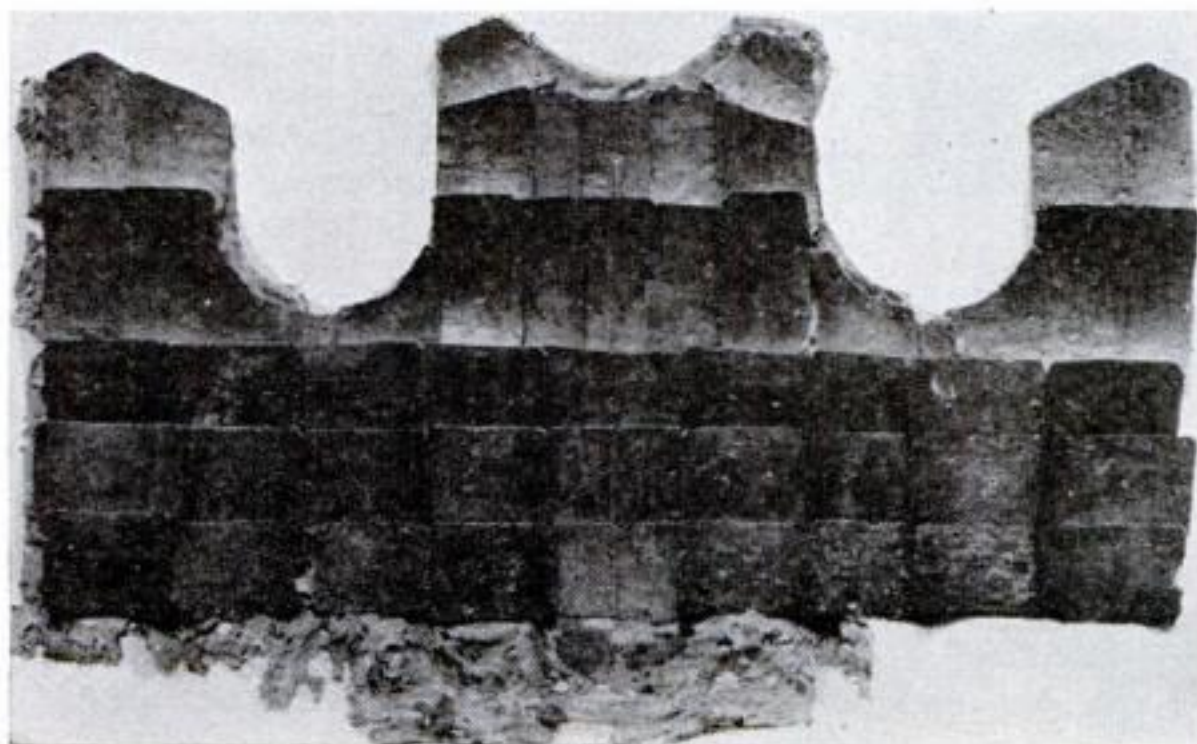
the armor shop of the one place in the United States where an intimate study of devices for protecting the body against wounds has been carried on for many years. It is New York's Metropolitan Museum of Art. The Museum contains magnificent samples of armor going back to the times of the ancient Greeks and Romans. Some of the models are fashioned with the same kind of planishing hammers as were used to repair the dented steel harness of King Richard the Lion-Hearted, back in the days of the Crusaders. (Continued on page 234)

Body Armor Is Not New



1916 Several types of armor for infantrymen were developed in World War I. In Berkley's "flexible armor guard," above, square pieces of metal were riveted to a canvas backing. It gave inadequate protection.

Metropolitan Museum of Art



1400 The Middle Ages were the heyday of armor. At left are the remains of an Italian "brigandine," originally consisting of 53 overlapping iron plates riveted to canvas. The length of the canvas indicates that the brigandine covered the abdomen and loins. Openings are holes for the arms.



Stableboys' Cooling-Off Job Is Now Done by Electricity

RACE horses at the Roosevelt Raceway, Westbury, N. Y., are tied to this new electric walker so they may cool off gradually

after work on the track. Arms radiating from the motor revolve to keep horses moving at the slow pace generally used.

Navy Issues Insignia for Air Navigators and Flight Nurses

AMONG the wing insignia recently approved are those for Naval Aviation Observers (Navigation), shown at upper right, and for Navy Flight Nurses (lower right). The former insignia, consisting of gold wings with a silver compass rose set on crossed anchors, may be worn by eligible Naval officers, including Waves. The Naval Flight Nurse insignia has gold-embossed wings and bears the anchor and oak leaf, symbol of the corps.



Mosquitoproof Cap Protects GI's Against Malaria

DISEASE carried by mosquitoes and other insects, to say nothing of discomfort, will be lessened by the development of a "jungle cap" by the AAF Board at the Air Forces Tactical Center, Orlando, Fla. The first cap assembly was made of a snag-resisting, 14-mesh nylon netting attached to the visor and a cellulose acetate window at eye level. Preliminary tests under difficult conditions in southern Florida enabled the Army to improve the cap by extending the visor backward to keep the netting away from the ears. A soft metal ring, which permits folding, is sewed into the netting to hold it down in front and back, and a drawstring secures it around the neck.





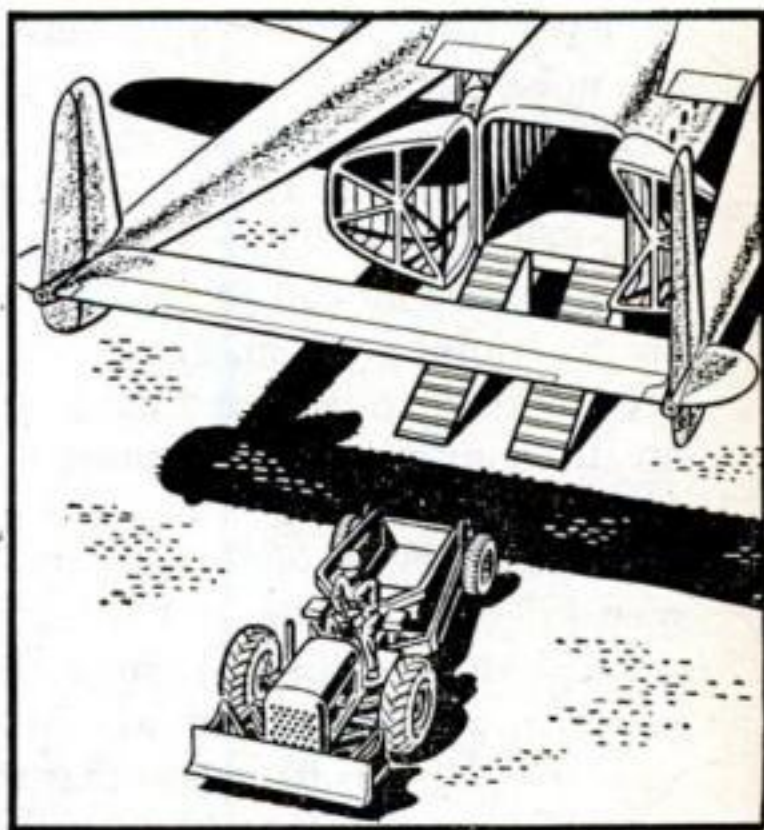
Nylon Pocket Litter Saves Wounded Marines Under Fire

WOUNDED men are brought out of the front lines with greater ease and safety by means of a new nylon litter developed by the U. S. Marine Corps Medical Field Research Laboratory at Camp Lejeune, N. C. Measuring 78 by 26 inches and weighing less than 2½ pounds, the litter can be folded to fit in a corpsman's pocket or pouch. Five straps

hold the casualty securely in place, while loops at the head end and sides make it possible to carry him in a variety of ways. One man can drag the litter over the ground, or the wounded man can be raised or lowered over a cliff. Hems at the sides permit use of poles cut on the spot for carrying by two men like a standard semirigid litter.

Army's Airborne Road Scraper Takes Bumps Out of the Road to Tokyo

AIRSTRIPS and roads on Pacific islands are being leveled by two-unit scrapers like the one below, which are flown out in giant air transports either assembled or in two sections. Equipped to dig, load, transport, dump, and spread the earth, the machine is powered by a 43-horsepower gasoline engine and mounts a bulldozer blade on the front and a cable-operated steel bowl scraper on a frame in the rear.



Annihilation Bomb

—Friend or Foe?

A Statement by the Editors of POPULAR SCIENCE MONTHLY

A CUBIC INCH of a star known to astronomers as the White Dwarf weighs about a ton, almost 6,000 times as much as a cubic inch of lead. This star may have pointed the way to atomic power—a discovery so momentous that the noted French physicist, the Duc de Broglie, calls it comparable only to primitive man's discovery of fire.

How could matter be as compressed as it is in the White Dwarf? One possibility that occurred to scientists was that this star consisted of atomic nuclei from which electrons had escaped. The supposedly indivisible atoms, in other words, appeared to have been broken apart elsewhere in the universe.

On August 6, 1945, an atomic explosion occurred within an annihilation bomb dropped on Hiroshima. *Popular Science Monthly* has looked forward to such a scientific triumph for many years; its editors are confident now that this discovery will create many more opportunities—not only for warriors, but also for physicists, chemists, astronomers, engineers, and all other men interested in the physical sciences.

Dr. Albert Einstein suggested many years ago that "E equals M times C squared." By this he meant that the energy in a unit of mass could be computed by multiplying the mass by the velocity of light squared. Such computations spurred scientists throughout the world to find a way to release the atom's tremendous energy.

A way has now been found. Even the biggest and the mightiest bombs developed previously could only hurl about familiar kinds of matter; the new atomic bomb is capable of changing minute quantities of matter into more concentrated energy

than can be obtained by any of the world's mightiest machines.

Nine million pounds of ammonium nitrate exploded near Oppau, Germany, in 1921, causing serious damage four miles away. That was the greatest weight of man-made material ever known to have exploded at one time. The exploding charge in the annihilation bomb weighed only a few pounds, but its effects were so devastating that it almost wiped out a city spread over nearly seven square miles.

Even so, Oppau and Hiroshima are scarcely comparable. In the kind of explosion that occurred at Oppau, materials such as steel have been torn into fragments, twisted and strewn over the countryside; at Hiroshima, steel appears to have been turned into gases.

You have seen corn popping in a pan. If the pan is removed from the fire the instant the first grain explodes, no more will explode. If you could see an atomic explosion, you might see something similar, but the units would go on bursting, each one setting off more explosions.

"No one knows how to halt disintegration of matter," Dr. Jean Thibaud of the University of Paris said only four years ago—but the world did not disintegrate when the atomic bomb burst on Hiroshima. Hence, it is clear that ways have been found to release predetermined amounts of atomic energy.

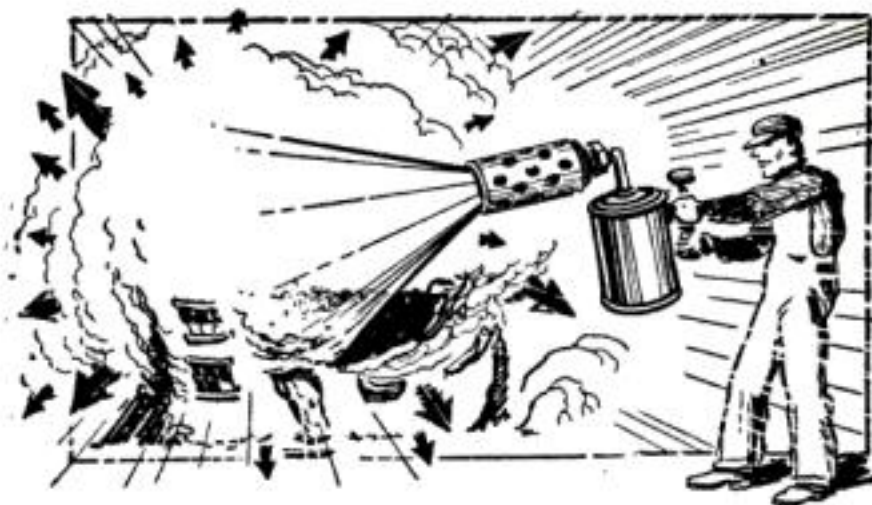
Conceivably, the subjection of some materials to an intensely hot atomic explosion may make them radioactive. How long this radioactivity continues depends on the nature of the material and the force to which it is subjected.

(Continued on Page 230)

HEAT IS SOURCE OF ATOM BOMB'S DEVASTATING POWER



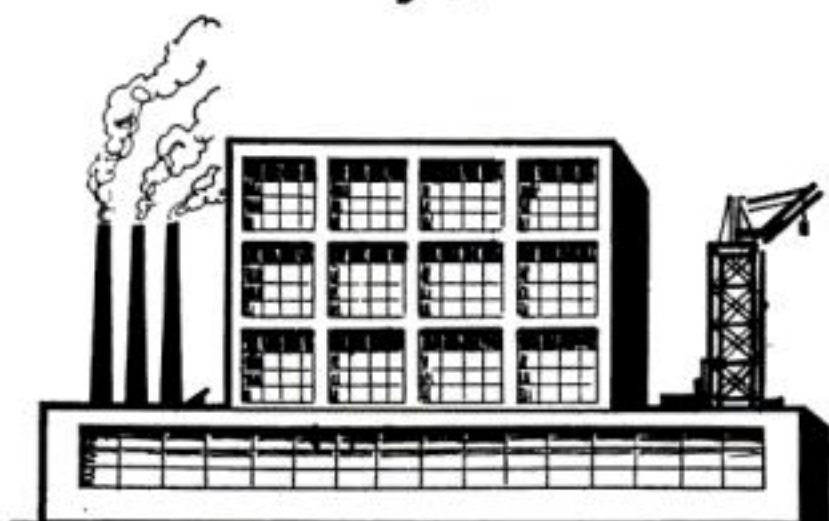
ORDINARY BOMB owes its destructive power to the release of hot, expanding gases produced by a chemical action in the explosive. The blast and fragments from the bomb push and pull near-by objects violently as though a hurricane had struck.



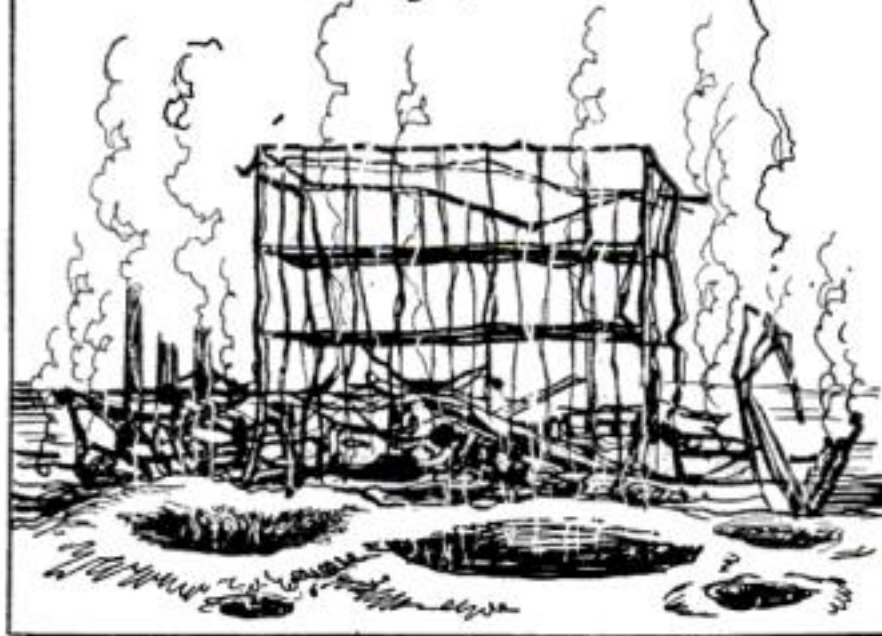
ATOMIC BOMB releases such tremendous heat that solid materials in the vicinity are vaporized. Force exerted is hundreds of thousands of times as great as that from the same weight of ordinary explosives. Effect on target is wholly unprecedented.

EFFECT OF ORDINARY EXPLOSIVE AND ATOMIC BOMBS

BEFORE



AFTER



BEFORE



AFTER



When a war plant or other target is hit by high-explosive demolition bombs, damage is limited to the immediate vicinity of hits, plus incidental fires. Even with the heaviest bombardment, it is hard to damage the target beyond all hope of repair.

As proved at Hiroshima, a single atomic bomb will completely obliterate the whole target area, turning what was once a busy industrial center into a lifeless and possibly uninhabitable waste. Nothing is left with which the enemy can start over again.

**WE'LL HAVE IT
AFTER THE WAR**

Soap Washes Hands as Clean as a Surgeon's

POPULAR SCIENCE
presents the first article of a
series on products, created or
improved by wartime re-
search, which will transform
our daily lives after the war.

THANKS to a new organic chemical with a 32-letter scientific name, your favorite toilet soap may soon take an active part in the fight against disease transmitted by bacteria on the skin. Odorless and nontoxic—except to germs—the chemical can be combined with any good soap without changing its appearance, cleansing quality, or scent.

MIXING G-11 WITH SOAP



The new bacteria-killing chemical, Compound G-11, added to ordinary soap, will make it a germicide. It can be added, as in the picture above, in an alcohol solution, or mixed dry with the other soap ingredients as shown below.

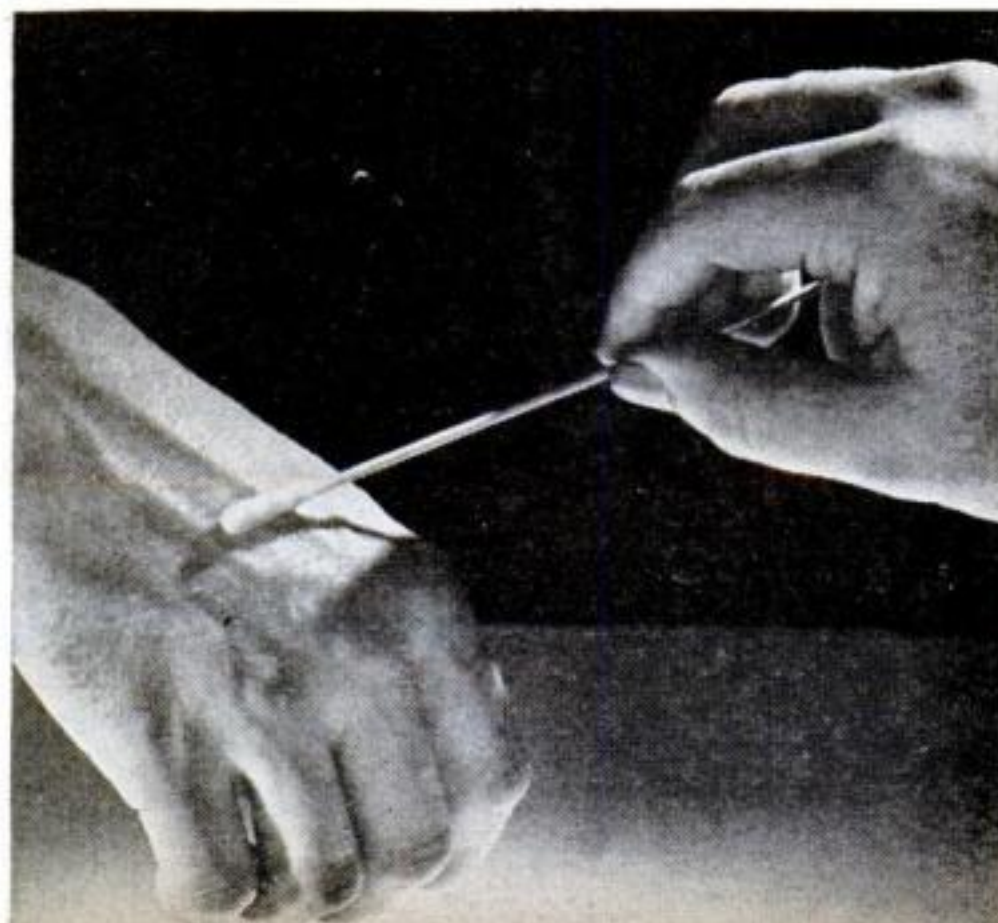


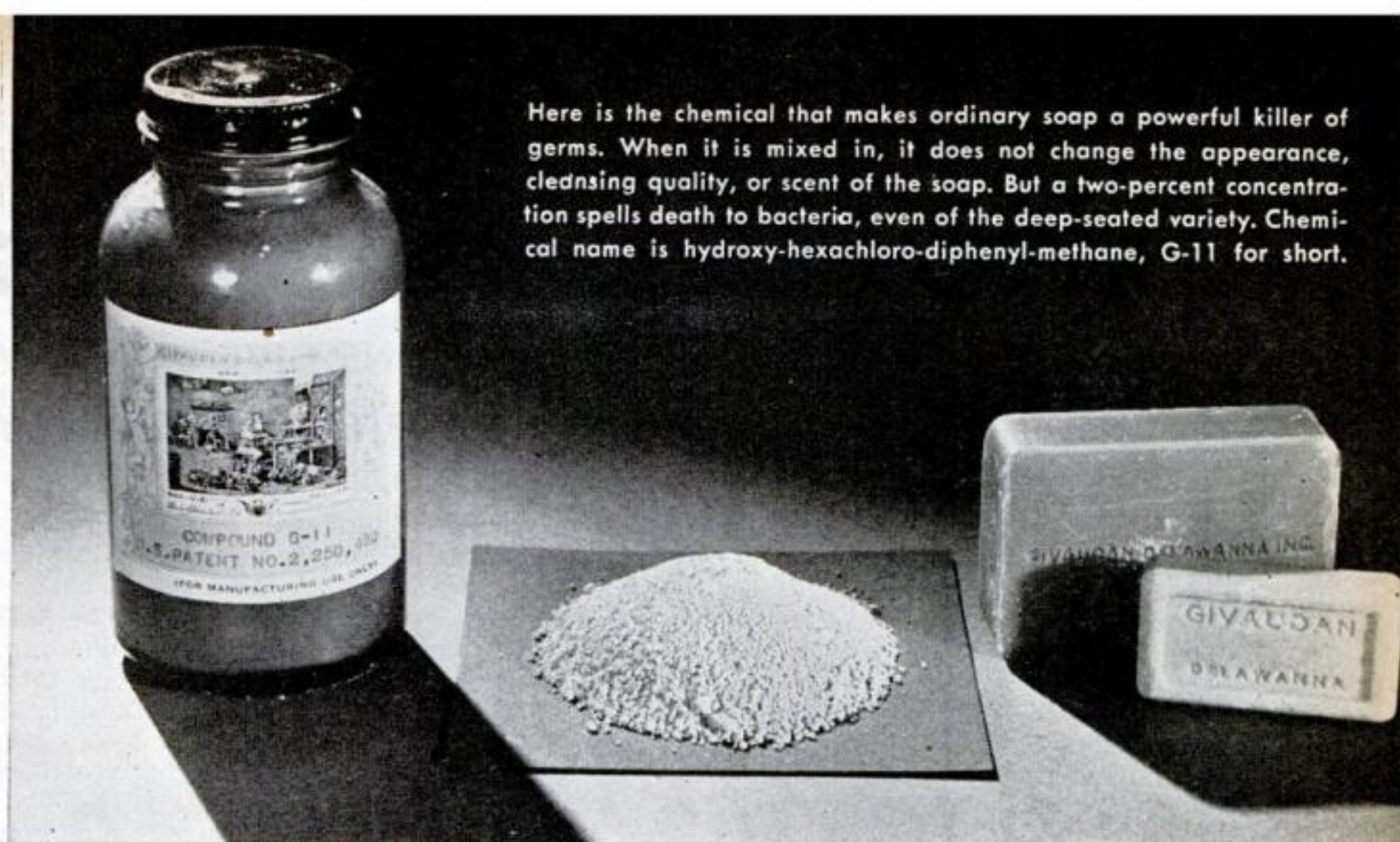
Use of soap containing this new chemical should simplify the present time-consuming scrub-up technique of physicians and surgeons. It would have decided advantages in public washrooms, Army camps, and on ships. In barber shops and beauty parlors, it would reduce skin infections; and in factories, restaurants, and hotels, it might lessen the hazard of communicable diseases. Compound G-11, as the new crystalline substance is called for short, was developed by Dr. William Gump, research chemist of Givaudan-Delawanna, manufacturing perfumers and chemists.

Washing with ordinary soap mechanically removes dirt, oil, and grease, and, along with this soil, a great many germs from the surface of the skin. These are the "transient" bacteria and fungi of all kinds that we pick up by contact with other people and things. Deeper in the skin structure lie the "resident" bacteria, belonging mostly to the group of staphylococci, which are more slowly destroyed. Fortunately, not all of these micro-organisms are harmful. As long as the skin remains healthy and unbroken, none of them, harmful or otherwise, can enter the body. But disease-producing bacteria *can* be carried on the skin from one person to another.

Although researchers had plenty of bac-

TESTS IN LABORATORY





Here is the chemical that makes ordinary soap a powerful killer of germs. When it is mixed in, it does not change the appearance, cleansing quality, or scent of the soap. But a two-percent concentration spells death to bacteria, even of the deep-seated variety. Chemical name is hydroxy-hexachloro-diphenyl-methane, G-11 for short.

teria-destroying substances to draw from, most of these became troublesome or ineffective when mixed with soap. Iodides and organic salts of mercury were among the first tried, but these found only limited use because soap containing them was poisonous and irritating to the skin. Phenol disinfectants failed when mixed in small amounts with soap because the soap ingredients reacted with them, producing new compounds with little germ-killing power.

Besides being nonpoisonous and nonirritating, and not reactive with soap materials, the germicide must also be nonvolatile and should not stain the skin or clothing. For popular use, it must not have a disagreeable odor. G-11 is the first substance to meet all these requirements. It is made by condensing two molecules of trichlorophenol with one molecule of formaldehyde

in the presence of concentrated sulphuric acid. Although the final product is a phenol, it is a complex product that only partially decomposes in the presence of soap. The part that remains unchanged deals death to bacteria.

Although G-11 has special advantages for primarily aseptic needs, it is inexpensive enough to be incorporated into all kinds of routine soaps—for hand use, bathing, shaving, dishwashing, and laundering. It is possible that the widespread use of such germicidal cleansing might improve the general public health by reducing contagion.

Hundreds of tests made on human subjects prove that washing with soap containing two percent, or even less, of G-11 not only removes and kills most of the skin's transient bacteria, but markedly reduces those resident in the deeper layers.

PROVE THAT G-11 KILLS HARMFUL BACTERIA

←
The proof of the germicide is in the testing. Back-of-hand swabbings were made, as at the left, on persons who had washed with G-11 soap for a week, and on others who had used ordinary toilet soap. Then

→
Cultures were taken with the results shown. The left-hand plate shows up colonies of bacteria from the hand washed with plain soap, while that at the right shows a smaller number of colonies after the use of a soap containing the germicidal agent.

WITH
ORDINARY SOAP

WITH
G-11



New Kickless Cannon for GI's

TWO-MAN RECOILLESS GUNS GIVE INFANTRY THE FIREPOWER OF FIELD ARTILLERY

Photographs by WILLIAM W. MORRIS
and HUBERT LUCKETT

AFTER 600 years, armament experts finally have found a way to take the "kick" out of gunfire. The discovery has put into the hands of American soldiers in the Pacific artillery that can be carried ashore on men's shoulders in amphibious operations.

Kickless, or recoilless, guns helped root

the Japs out of Okinawa. For certain operations, a few infantrymen can lay down as heavy a curtain of fire as a whole battery of medium artillery. They can do it because the Ordnance Department has annulled, for all practical purposes, Isaac Newton's third law of motion: For every action there is an equal and opposite reaction.

Here are a few samples of what recoilless artillery has accomplished:

Two rounds from a 75-mm. gun, used by the 17th Airborne Division in Germany, knocked out a German 88 and an antiaircraft gun concealed in a barn. A hundred Germans tumbled out to surrender.

On Okinawa, one shot from a gun of the same caliber destroyed a camouflaged machine-gun nest and killed two snipers in it at a range of 400 yards.

At a range of three quarters of a mile, 11 rounds from a 75-mm.

U. S. KICKLESS GUN

The Germans developed a recoilless gun (below, right) for use by paratroopers, but it is bulky compared with the trim U. S. cannon shown at left and below.



57-MM. Weighing only 45 pounds and 61 inches long, the 57-mm. can be fired from the shoulder as accurately as the Garand. It hurls a 2¼-lb. shell 2½ miles.

75-MM. The kickless 75 can toss a 14-pound, high-explosive shell more than four miles. It is 82 inches long, weighs 110 pounds, and is fired off a machine-gun tripod. It has both a telescopic and a leaf sight.





In this U. S. Army Ordnance Department photo a group of four of the new 75-mm. recoilless rifles lays down a heavy curtain of fire. Conventional artillery shells are used, but the normal recoil is absorbed by allowing a controlled portion of the propellant gases to escape through openings in the gun's breech.

gun scored two hits on each of two caves concealing Jap artillery. All the Jap gunners were killed.

At a range of $1\frac{1}{2}$ miles, seven shots from a 75 scored three hits in a cave mouth measuring five by two feet.

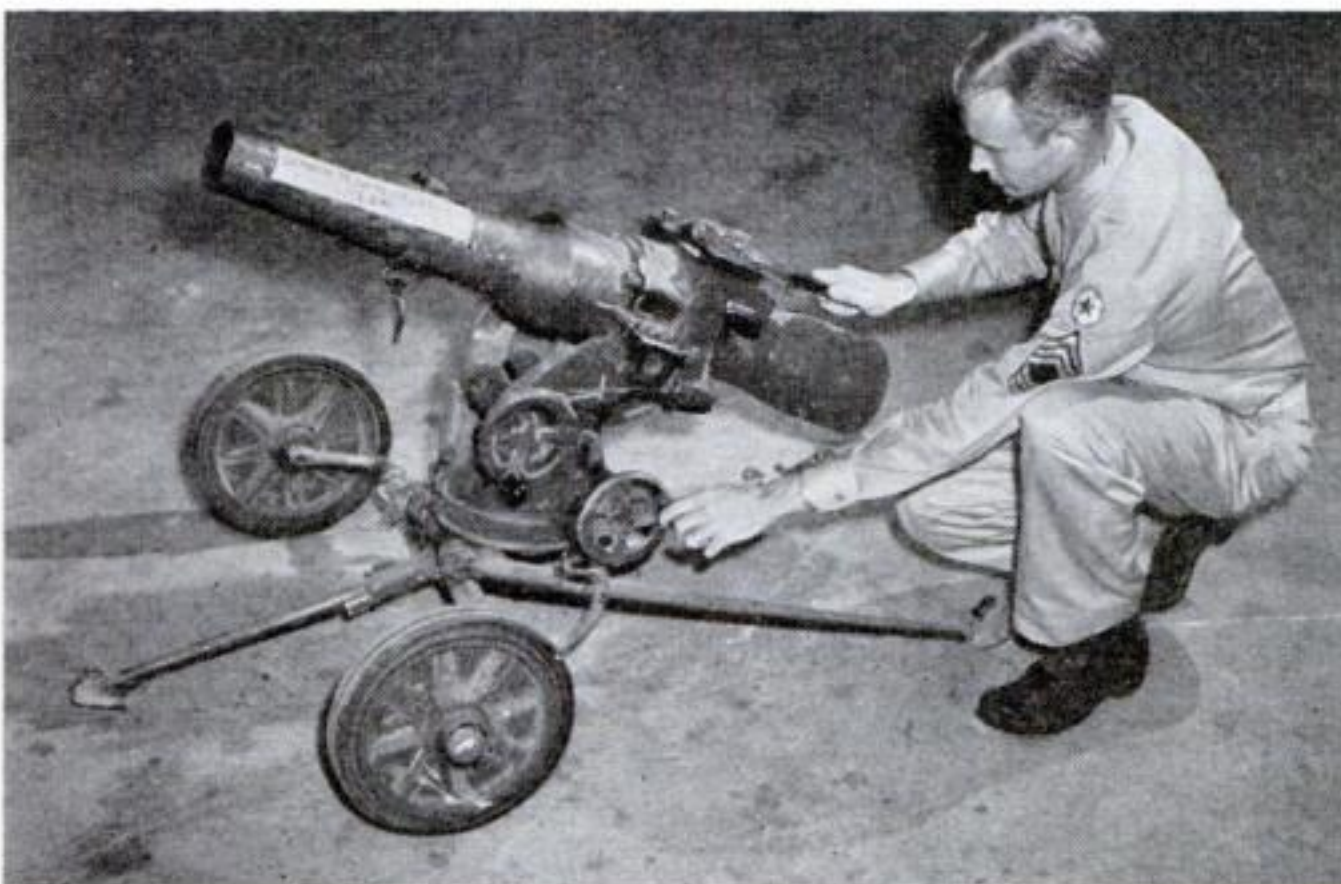
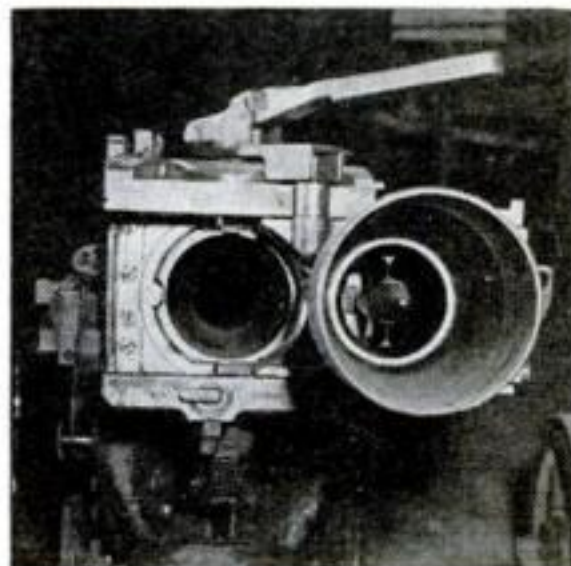
Recoilless guns are not tubes throwing rockets, like the familiar "bazookas." They are guns in every sense of the word. They

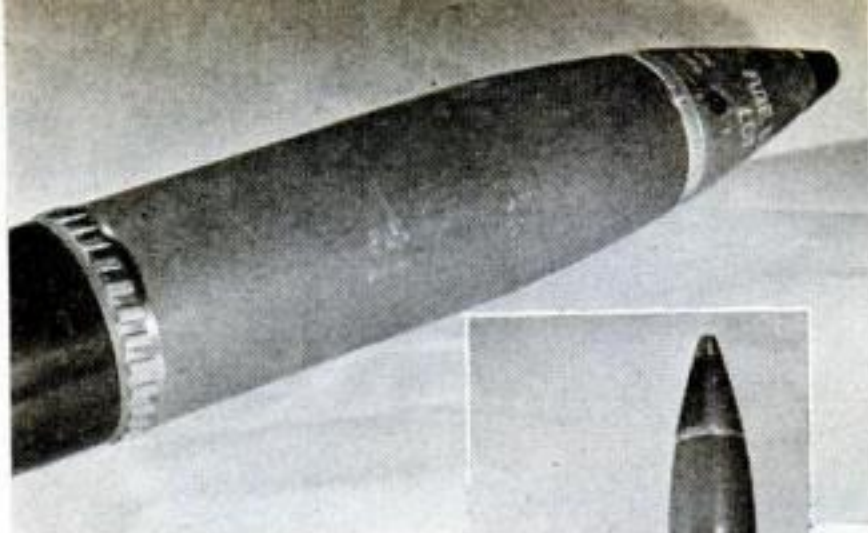
throw explosive ammunition or smoke shells. The shells are propelled by a powder charge. But right there the similarity stops.

All guns, except those of this particular type, "kick" when they are fired. That is because the propelling powder, suddenly becoming gaseous, expands tremendously and seeks an outlet from its confinement. The force of the expansion is exerted in two

SURPASSES THE GERMAN MODEL

The Nazi weapon is a 7.5-cm. with a range of 7,400 yards, but it weighs 325 pounds assembled in the field. At the right is a close-up of the gun's breech and (right, below) a blowout patch used to permit gas to escape to take the "kick" out of the gun.

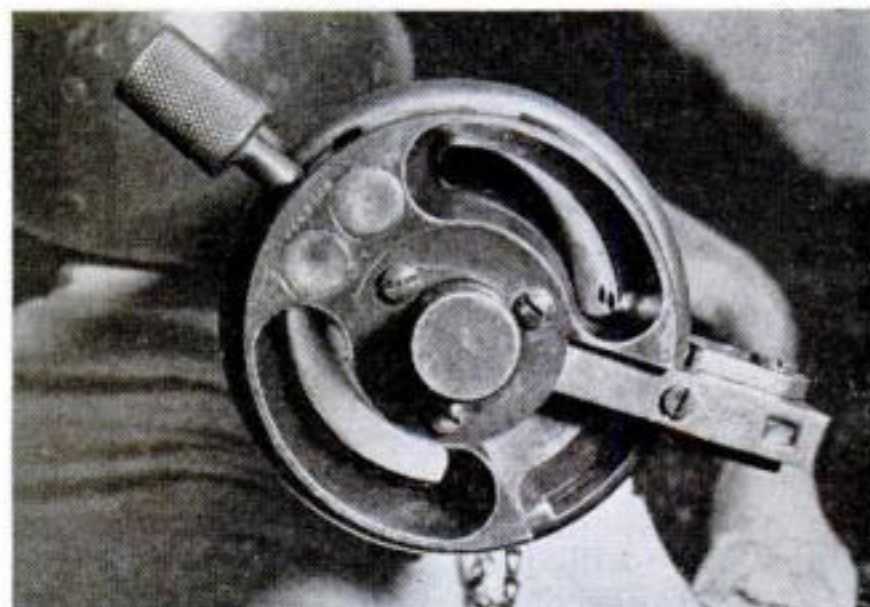




The perforations in the shell cases of the 57-mm. and 75-mm. recoilless ammunition permit escape of gases to the vents in the breech. The propellant powder is contained in a paper interlining. Note the pre-engraved rotating band on the 75-mm. shell above. This permits a thinner barrel wall, and the band must be fitted into rifling of the barrel to close the breech.



The loader of the two-man crew works from the side when inserting a shell into the milk-bottlelike breech of the 57-mm. gun. After locking the breech, he is clear of the blast that shoots back 40 feet.



Here's a close-up showing the ports in the breech, through which the propellant gases escape, eliminating the recoil. The powder charge is twice that of the standard artillery shell, so that sufficient gases also drive the projectile out of the barrel.

directions: half of it drives the shell from the barrel, half of it kicks back to produce recoil. Much of the weight of any ordinary artillery piece is devoted to a mechanism to absorb recoil.

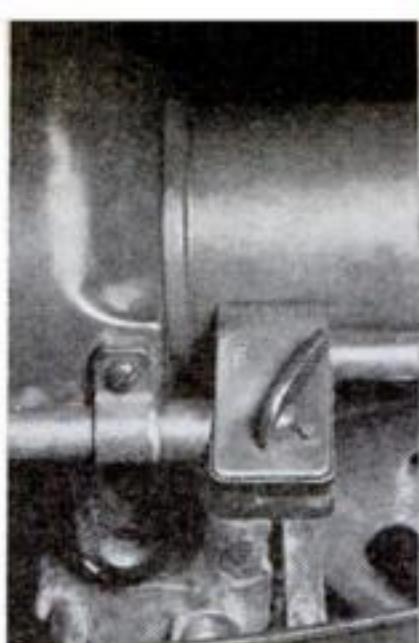
In obviating recoil, the U.S. Army has engineered not only one of the great developments of this war but one of the significant advancements in the history of gunfire.

SHOULDER REST OF 57-MM. IS BIPOD FOR PRONE FIRING

A quick adjustment converts the shoulder rest into a bipod for firing from the prone position. The 57-mm. can also be set on a machine-gun tripod.

This two-man artillery team presents a small target to the enemy. Loading the weapon is fast and simple. After the loader inserts the charge, he grips handle on the breechblock to close the breech, holding projecting handle on breech to steady gun.





This is loader's safety lever. When he moves it to "F" he taps gunner, signaling gun is loaded.



The new-moon-shaped shoulder piece cushions the gun's weight in the sitting and standing firing positions. Right hand squeezes trigger as left steadies weapon.



Here's the trigger assembly and the leaf sight on the gun's barrel. The trigger is at the forward side of pistol grip; safety grip is at rear.



The recoilless cannon looks much like the bazooka from a distance, but, unlike the bazooka, it throws regular high-explosive ammunition or smoke shells which are propelled by a powder charge. Because of the comparatively low muzzle velocity, specially shaped projectiles are used which will penetrate most tank armor. Above, the gunner spots his target in the telescope sight of the infantry's artillery weapon.

This is how an American infantryman shoots shells up to three inches in diameter without recoil: As in an ordinary gun, the propelling gases move two ways, forward and back. But those moving back, instead of encountering the sealed breech of the gun, find ports, or holes, permitting escape. The effect is somewhat like pulling a chair out from under someone about to sit down. What should be there simply isn't.

The question naturally arises, if the gases escape from the breech, what drives the shell forward? That's the secret. The loss of gas is compensated for to a large extent by using a larger powder charge than in a conventional gun of the same size. The amount of gas escaping is a *controlled* portion. The force of the gas expended in push-

ing the shell from the barrel of the gun is exactly balanced by the force lost through the holes.

Shoulder portability for artillery is gained, but in the process something is lost, as we shall see in a moment.

Against the Japanese, American troops are using two calibers of kickless guns, 57 and 75 mm. Each can be transported from ship to shore or across practically any kind of terrain by two men. One man, in fact, can carry the 57 if need be, and fire it. Usually, however, it is handled by a two-man crew—a gunner who carries and fires the weapon and a loader who lugs the ammunition and loads it. Under normal combat conditions the loader can carry six rounds, or 30 pounds (*Continued on page 238*)

Convair B-32 Bomber Is Hitting the Japs

NEWEST of the AAF's big bombers, the Consolidated Vultee B-32 is now in action in the Pacific. Designing of this big brother of the B-24 Liberator began before Pearl Harbor, and the production model now hitting the Japs is the result of long experimentation. The B-32's 135-foot wing span is only about six feet less than that of the Boeing B-29 Superfortress. It has a gross weight of 100,000 pounds. Four 2,200-hp. Wright Cyclone engines spin 16 $\frac{2}{3}$ -foot Curtiss electric reversible-pitch propellers, the largest-diameter props that have ever been installed in any production airplane.



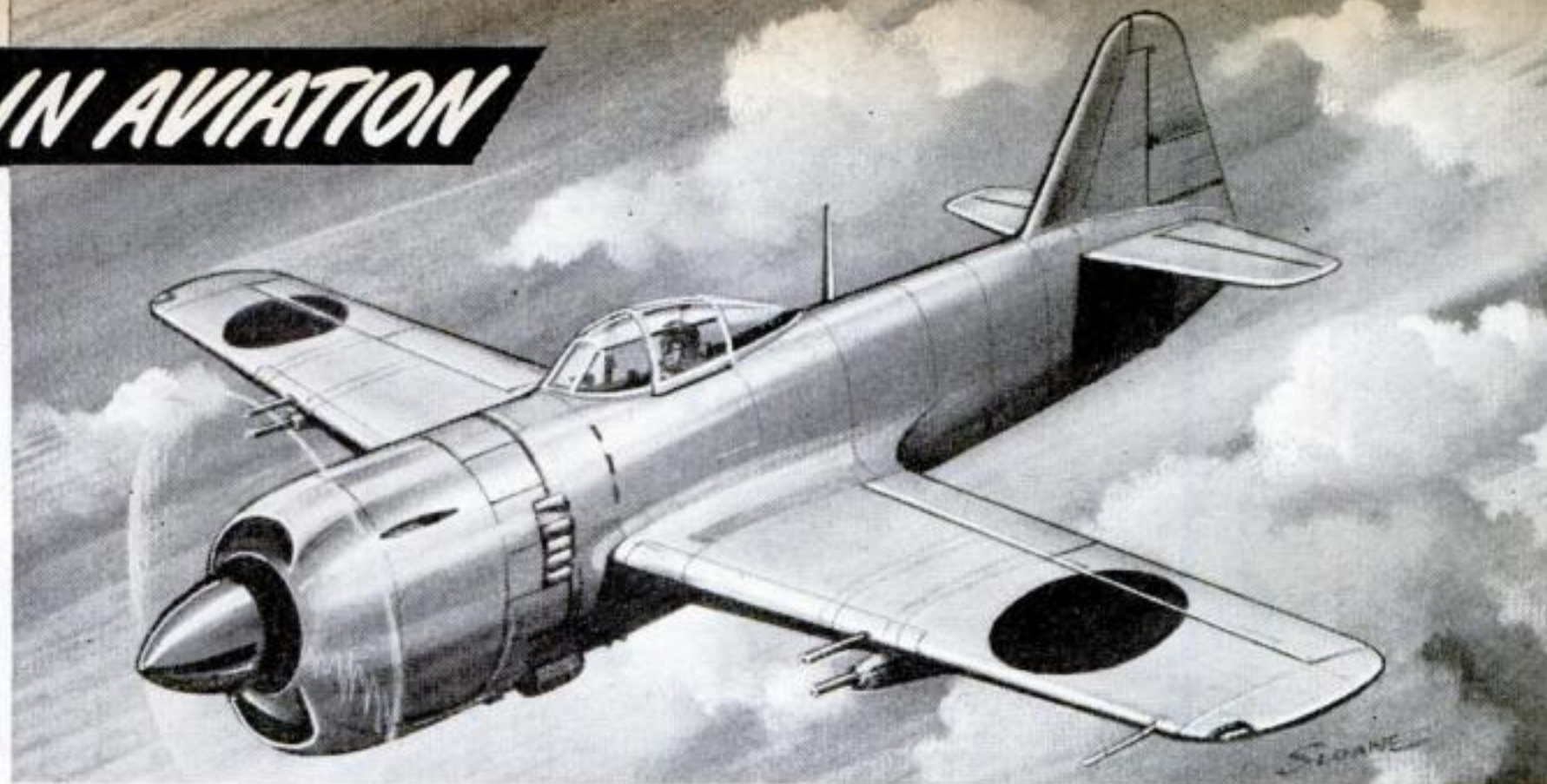
The towering tail surface of the B-32 rises 32 feet above the ground in taxiing position. Its vertical surface area totals 236 sq. ft.; rudder alone, 70 $\frac{1}{2}$ sq. ft.

The B-32 in flight. Single tail and cigar-shaped fuselage differentiate it from its famous smaller sister, the B-24 Liberator bomber.



Lights Show If Gear Is Down for Safer Landings at Night

PILOTS of Pennsylvania-Central Airlines planes, coming in for night landings, don't have to worry about whether the retractable landing gear is really down and locked. Mirrors alongside the landing lights in the wings reflect light onto the wheels, affording a positive check on the indication given by a signal lamp on the instrument panel.



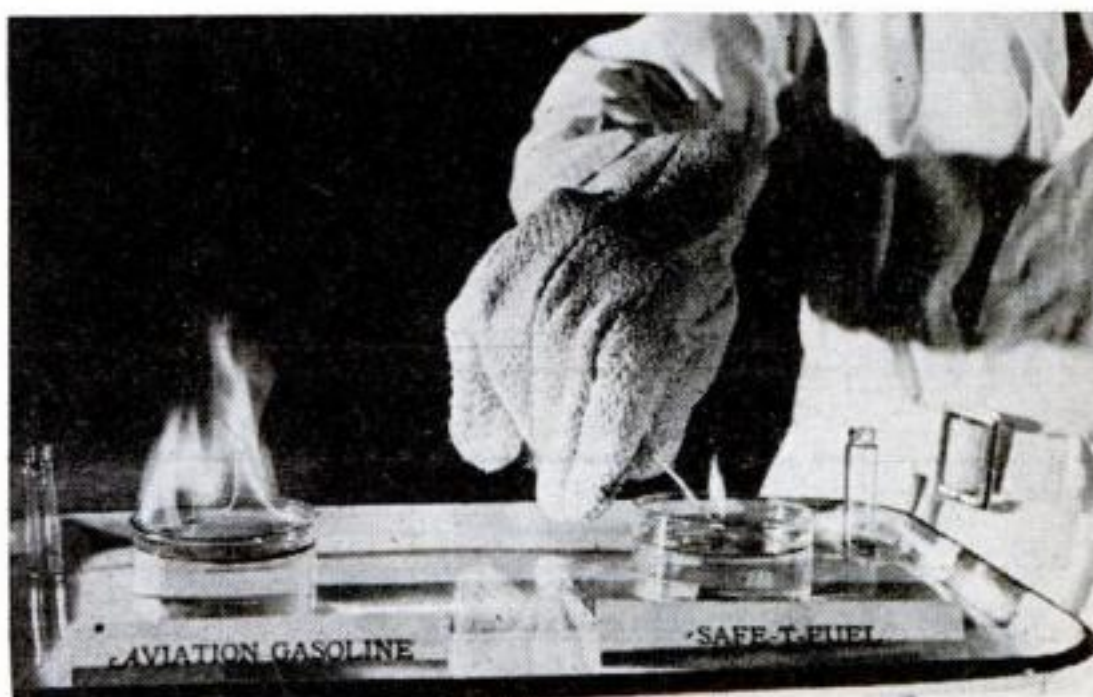
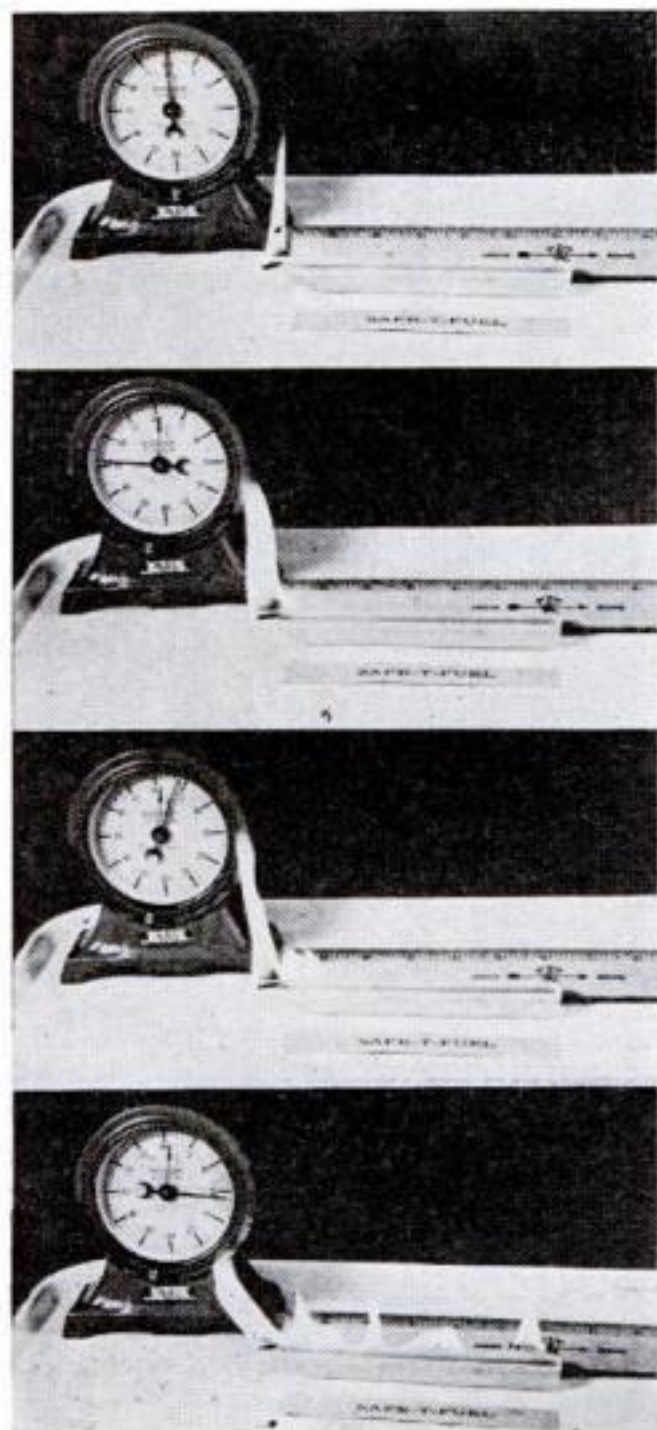
Meet George, the Japanese Answer to the Grumman Hellcat

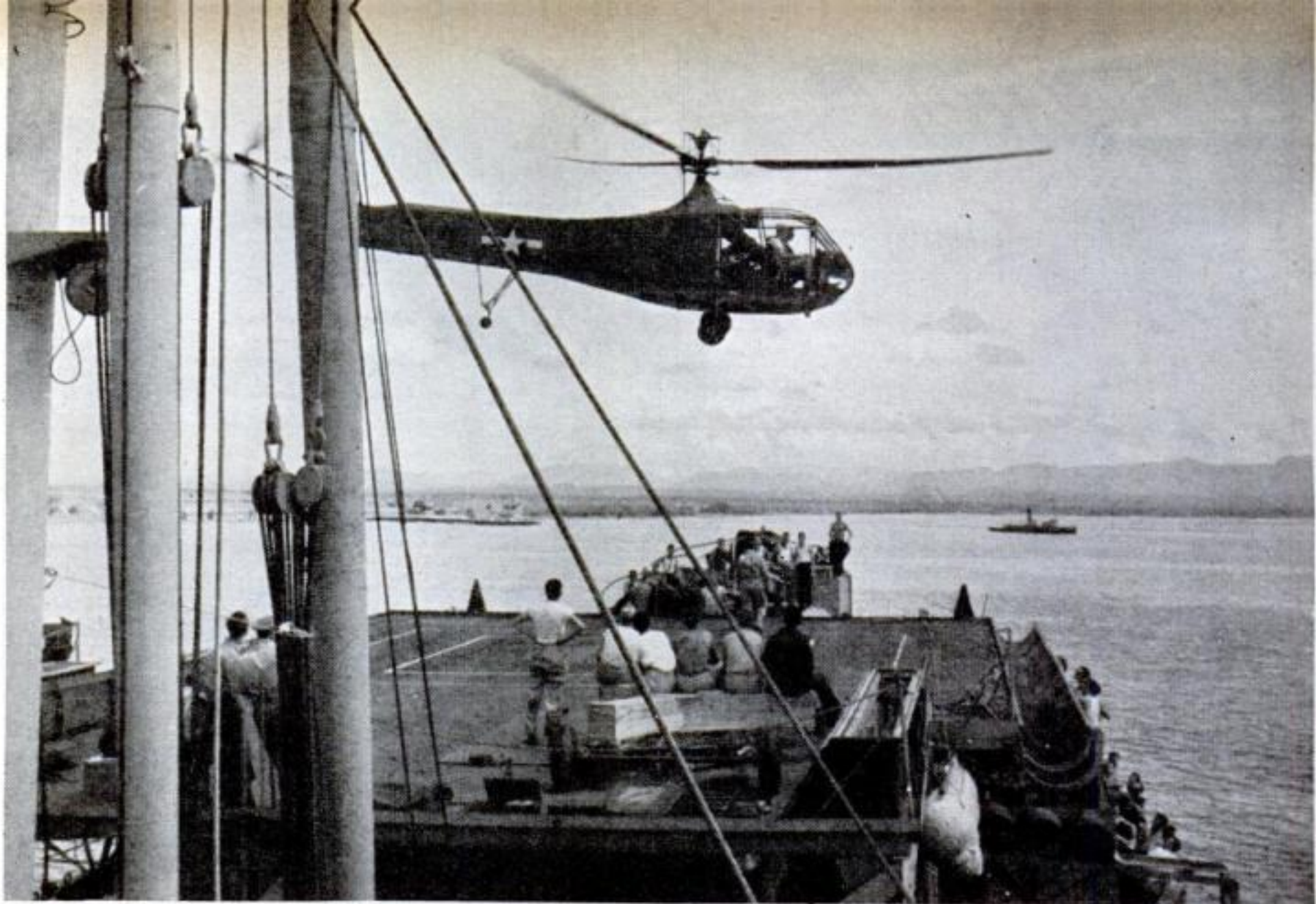
"LET George do it" will probably be the motto of the Japanese naval air arm, for this fast new fighter is about the best that the Nips can put into the air against our Grumman Hellcats. With its 2,000-hp. Homare 21 engine, George fights in the 400-m.p.h. class and is a little faster than most Allied carrier-borne fighters. Armament consists of four 20-mm. cannon in the wings

and two machine guns mounted in the engine cowlings and synchronized to fire through the four-bladed propeller. Allied air experts who know George's potentialities expect that the new ship will be used in short-range land-based operations exclusively. Like "Betty," "Zeke," and other names for various Japanese aircraft types, "George" is a tag applied by U. S. airmen.

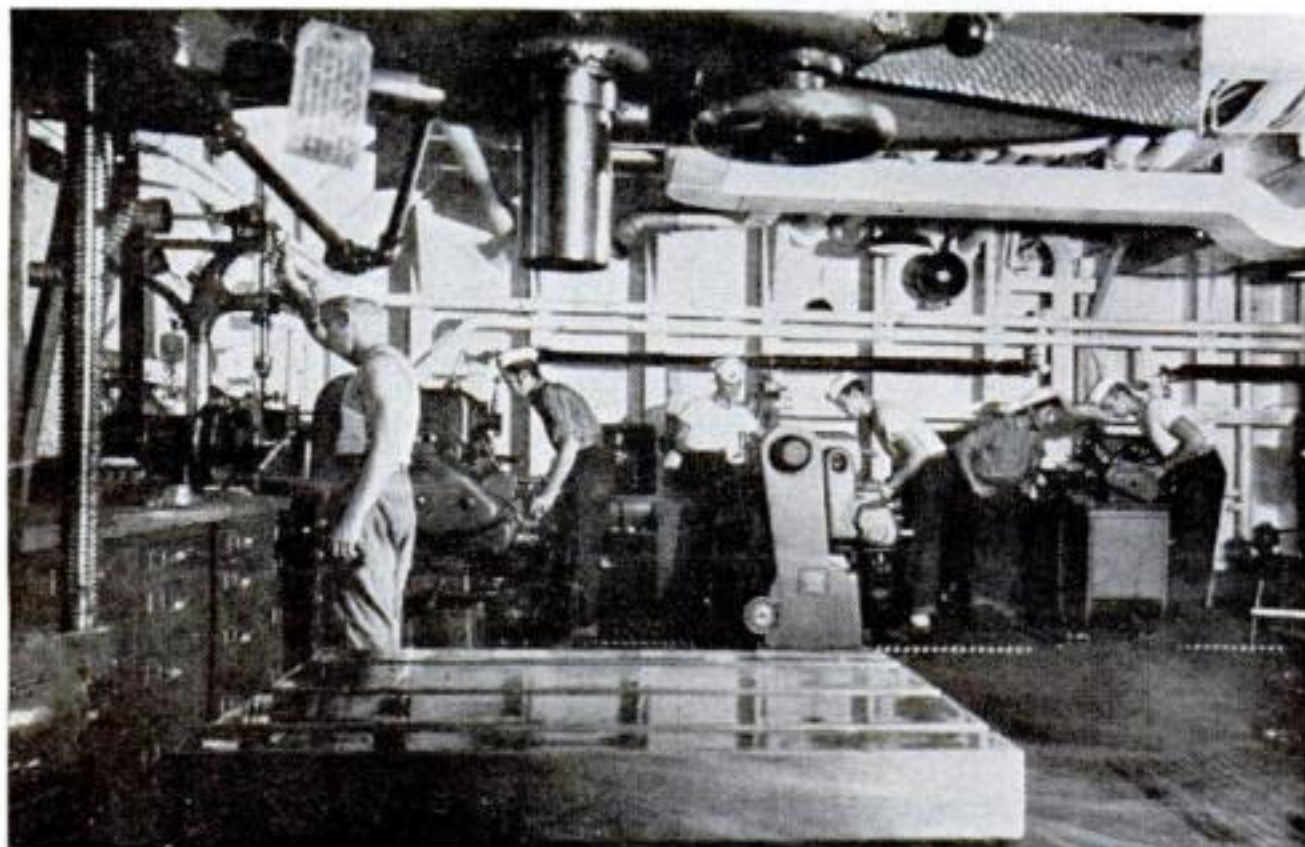
Safety Fuel Ends Flash-Fire Peril

DROPPING a lighted match into high-octane aviation fuel needn't be fatal, if it's the new safety fuel developed by the Standard Oil Company of New Jersey. With the combustion power of 100-octane gasoline, "Safe-T-Fuel" is as safe to handle as kerosene. It must be heated to above 100 degrees F. before it produces vapors that will ignite. In use, it must be fed by direct injection instead of carburetion. The pictures at the left show a test in which it takes 76 seconds for a lighted wick to set a tray of the new fuel aflame. Below, a lighted taper is dipped in Safe-T-Fuel without igniting it, while regular aviation gasoline burns fiercely after receiving the same treatment. The new fuel actually extinguishes the flame on the taper.





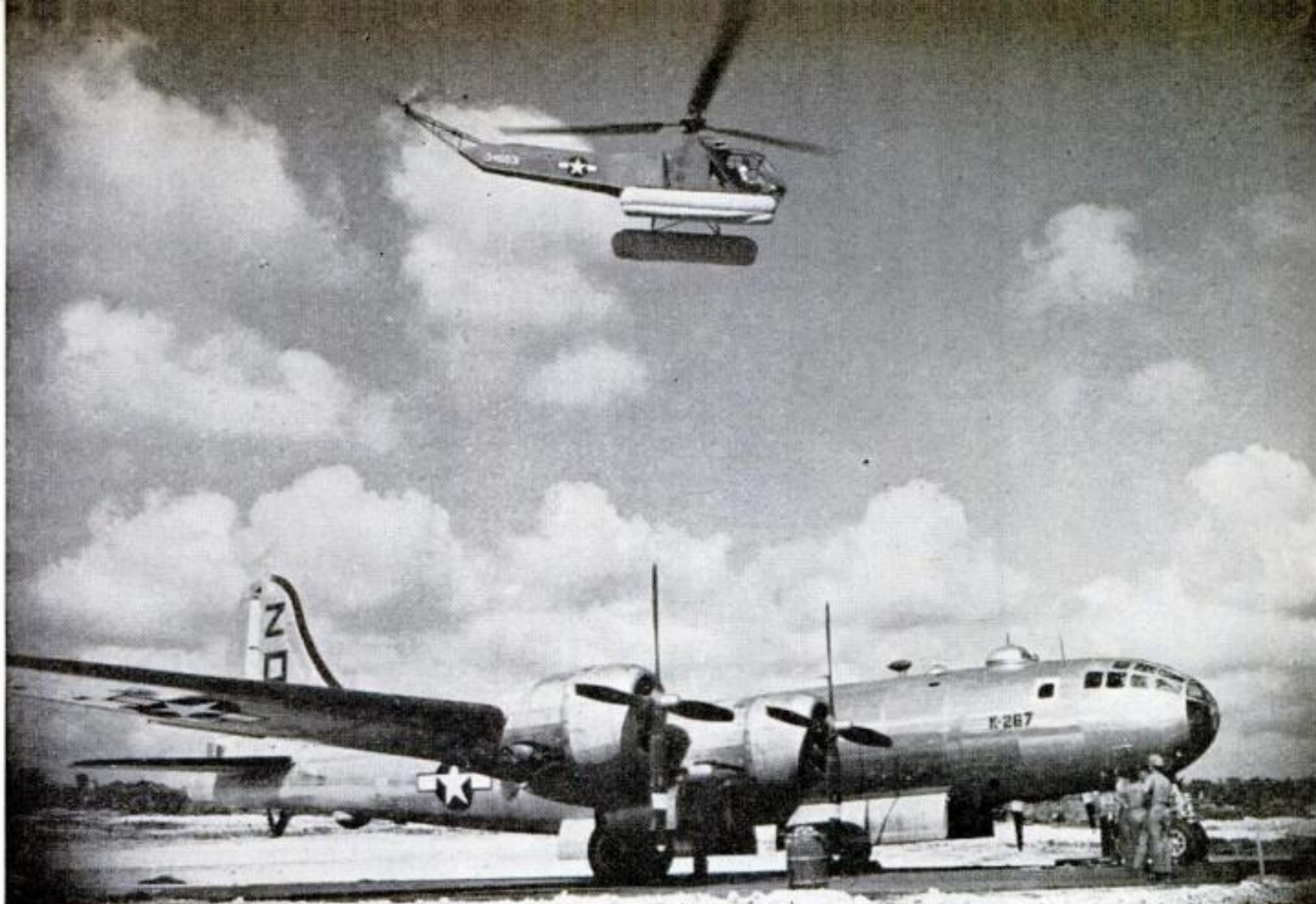
A helicopter rises from a floating B-29 repair shop to fly officers to a newly won airstrip on a Pacific island. Each "floater" also carries two "duck" trucks, two jeeps with trailers, and two 30-foot work boats.



All available space below deck is crammed with machine tools. The shops are equipped to handle sheet-metal jobs and to repair airframes, superchargers, carburetors, propellers, electrical systems, radios, turrets, and other parts.

Air view (below) of a re-fitted Liberty ship that ministers to damaged B-29's as a mother ship tends a group of submarines under its wing. These mobile depots serve until ground units reach advance bases.





Repaired parts and skilled men to install them are flown to a field ashore in a ponton-equipped helicopter. The seagoing mechanics can do just about anything in servicing the 55,000 parts of the big bombers.

Seagoing Shops Keep the B-29's Pounding Japan

All that our Superfortresses need is a place to land. The floating repair unit anchors near by and keeps 'em flying until ground bases can be set up.

By T/SGT. AMOS LANDMAN

BY BRINGING the repair base to the Superfortress, instead of vice versa, the timetable of the Pacific war has been speeded up two to six months. The Army Air Forces now reveals another of its schemes for blasting the Japs in their homelands—complete repair shops aboard Liberty ships.

Those floating repair bases simply pull up alongside a newly captured island and go directly to work to keep the B-29's in tip-

top shape for their mighty bombing attacks. They can do just about anything in servicing the 55,000 parts of the big planes. After there has been time to establish repair bases on land, the floating shops pull up anchor and move on to the next island.

The Liberty ships, which were converted to their new use by the Air Technical Service Command, are known officially as Aircraft Repair Units (Floating), but the seagoing AAF mechanics who work aboard them have boiled it down to "floater."

Not only is this new-type ship fitted with such shops as are needed for its mission, but it also is equipped with quarters and mess facilities for its personnel work, intelligence officer, finance officer, chaplain, laundry, PX, library, movies, and a complete hospital.

Floaters carry their own local transportation, for use at the scene of operations, right on their backs. Perched above the forward portion of the main deck is a 72-by-40-foot flight deck from which Sikorsky R-4B helicopters operate. Just aft of the flight deck are two "ducks" and two jeeps with trailers. On the fantail are two 30-foot work boats.

Here's how the floater works: When B-29 operations began in Saipan last November, the planes were experiencing trouble with



Finest precision work is done in this instrument shop, where compasses, bombsights, gyros, gauges, and other vital parts are completely overhauled. Many of these men were watchmakers in civilian life.

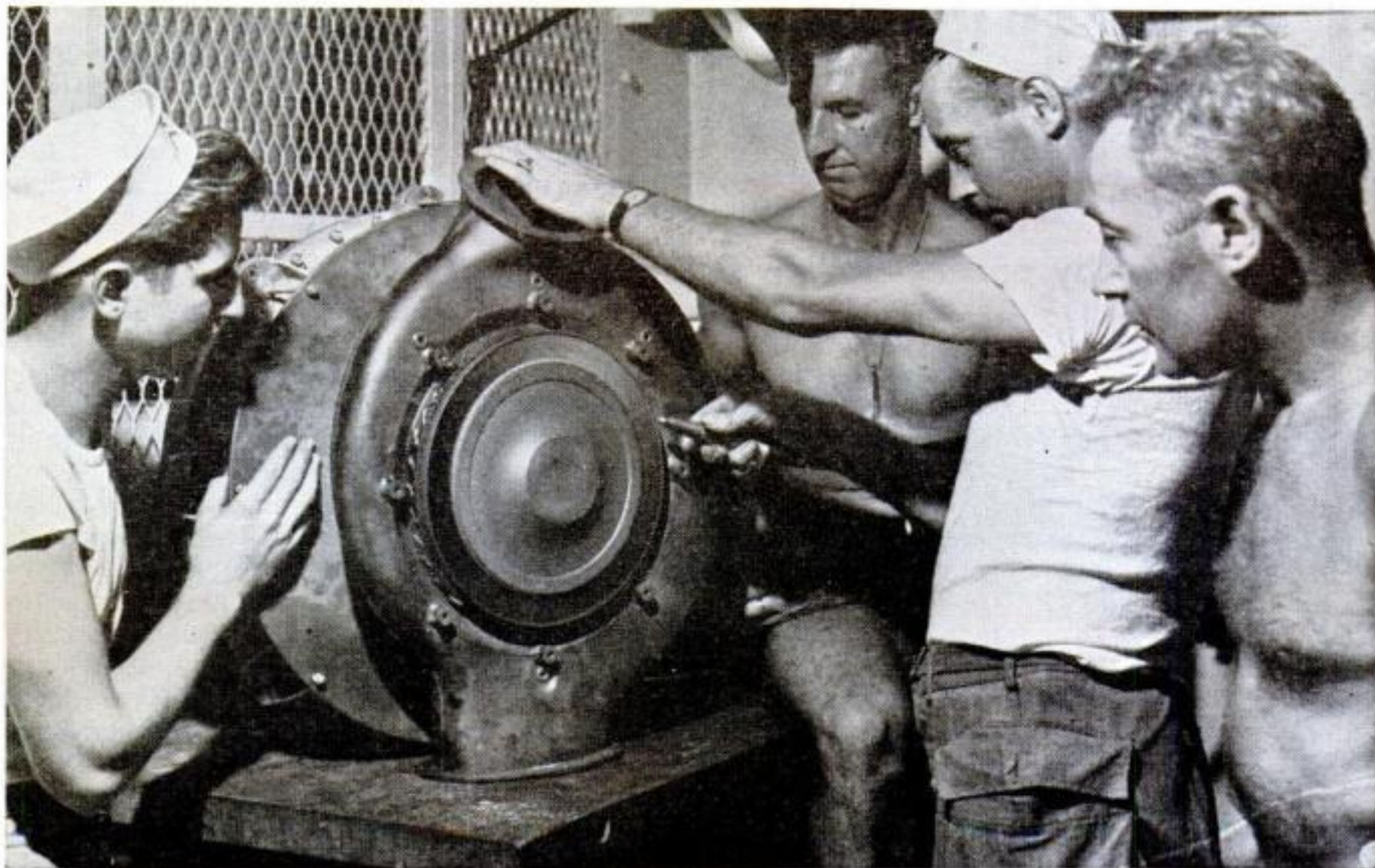
their prop governor heads. A clip which held a resistor was defective. The vibration of the engines loosened the clip, and the resistor, which looks like a cartridge-type fuse, popped out of the clip, got into the moving parts of the governor, and sometimes ripped it to pieces.

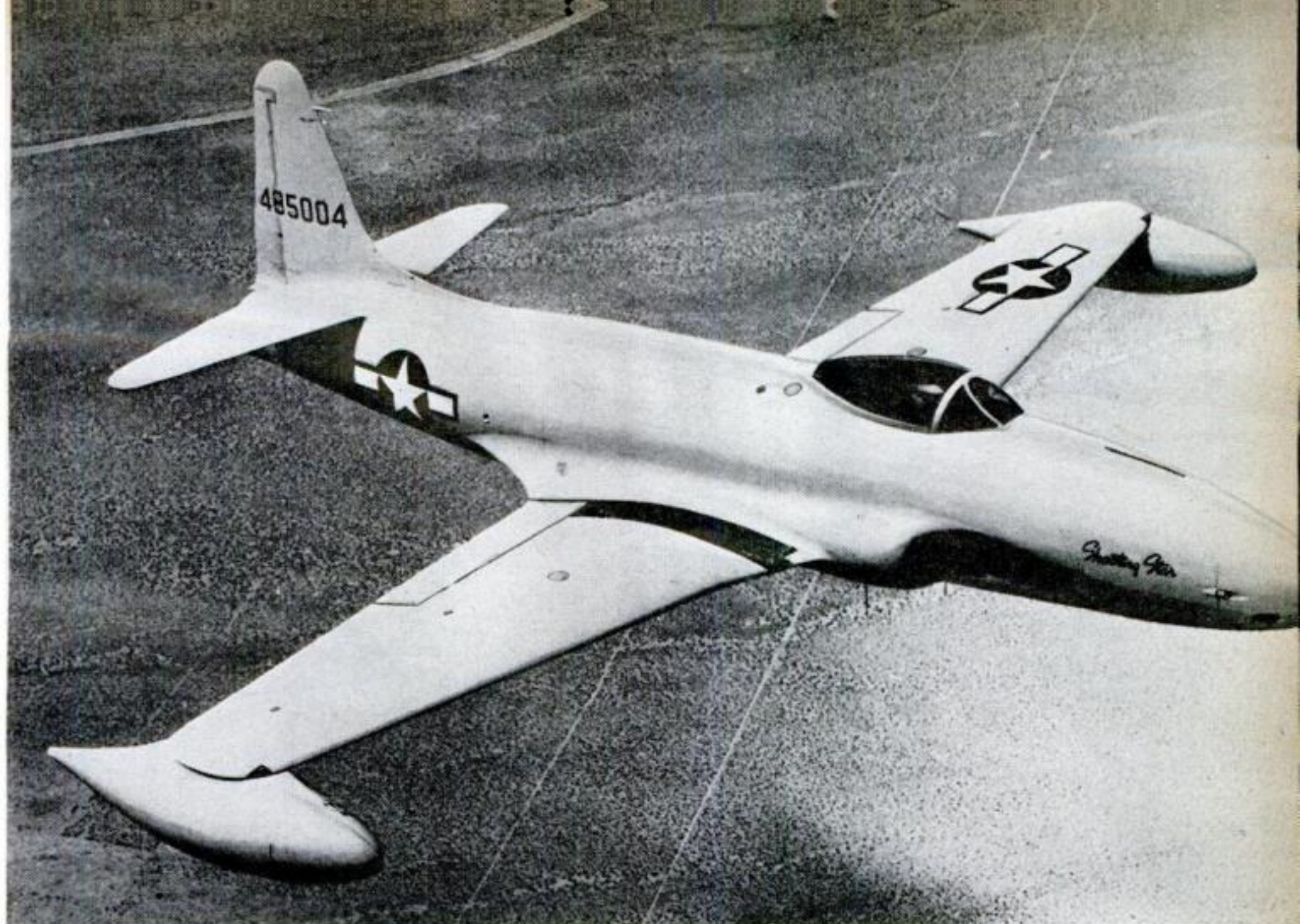
One of the floaters arrived in Saipan the day before the first Tokyo raid, and dropped anchor in Garapan harbor. Tactical outfits at Iseley Field rushed some 50 damaged prop governor heads to it for repair. Working at top speed, robbing some of the beat-up mechanisms for parts, and improvising, the men of the floater that night had a number of governor heads in serviceable condition.

The repair units are equipped with the following shops: machine shop, welding, sheet metal, heat treating, electroplating, ordnance, turret, ground and airborne radar, radio, camera repair, propeller, carburetor, turbo-supercharger, electrical, paint-dope-and-fabric, woodwork, instrument, bomb-sight, tire, fuel cell, parachute rigging, and drafting. There is a plant for the generation of aviators' breathing oxygen, the largest mobile plant of this kind overseas.

The B-29's aren't the only customers. The floaters have done work on P-51's and can handle work from any other planes, Army or Navy. One outfit even manufactured some gears for Seabee bulldozers when the Seabees were in a jam, and another capped the tires of a general's staff car.

Repairmen prime the oil pump of a B-29 turbo-supercharger. This department can overhaul 20 internal or gear-driven superchargers a month. Sandblasting of parts is done in the ship's electroplating room.





The camera catches a Shooting Star. The P-80 has a wing span of 38 feet 10½ inches and is 34½ feet long. This one is carrying auxiliary fuel tanks on its wing tips for use in long-range missions.

P-80 Secrets Revealed

A CLEARER picture of the fastest plane in the world, the Lockheed P-80 Shooting Star, is given by photographs just released for publication and performance details now made available for the first time.

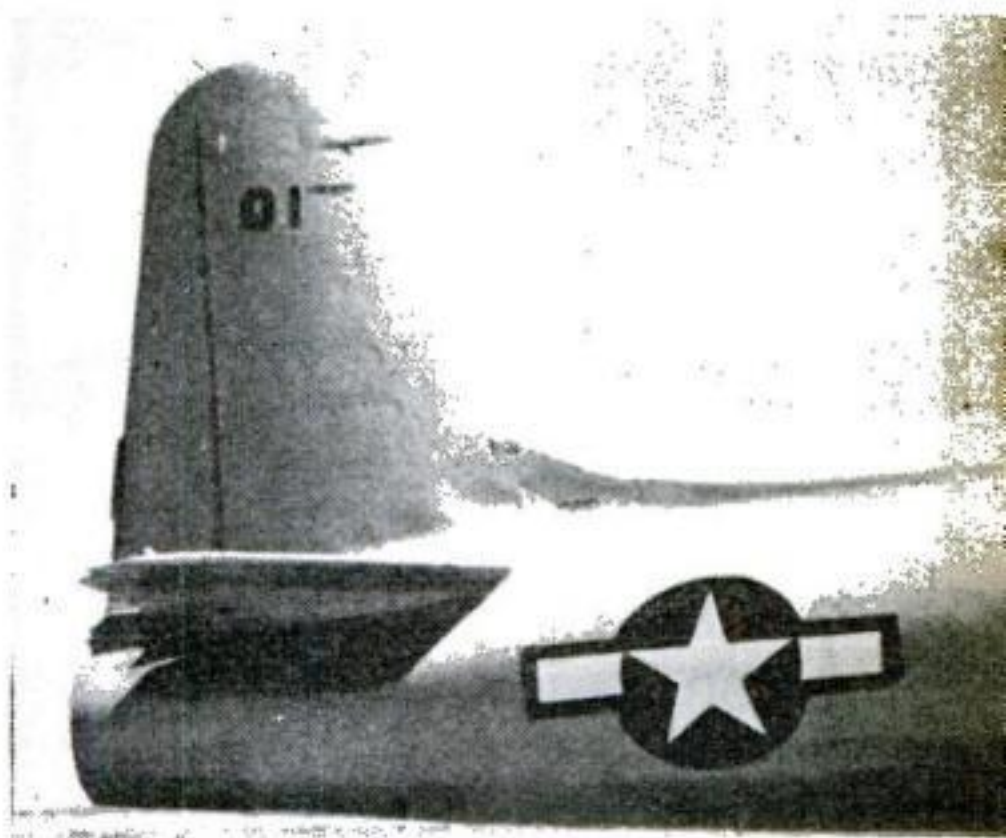
It can now be revealed that this jet fighter has a ceiling well above 45,000 feet. Armament is six .50 caliber machine guns in the nose. The pilot is protected by a bullet-resisting glass windshield and by armor plate fore and aft of his seat. Air pressure in the cockpit is automatically reduced in combat to prevent explosive decompression if a bullet hits the canopy.

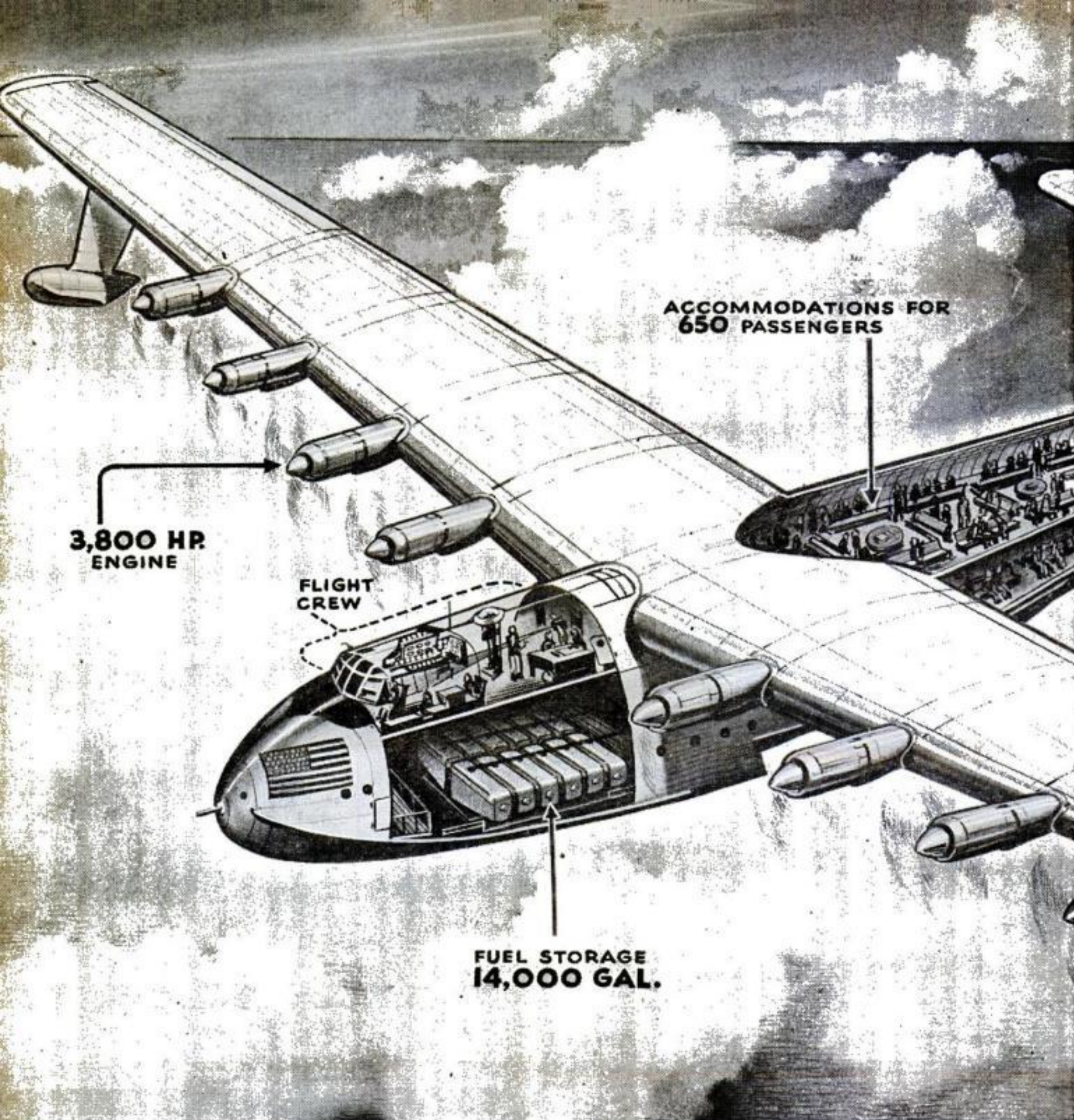
Gross take-off weight of the P-80 is about 14,000 pounds, some two tons less than that of the P-38 Lightning. The kerosene-burning General Electric jet engine, which has only one moving part and requires no warm-up period, can be completely changed in less than 20 minutes. There is only one engine control: the throttle.

Because it has no propeller to clear the

ground, the Shooting Star is able to use extremely low tricycle landing gear. A "piano finish" is given the whole outside surface of the plane by the use of a special primer with baking, waxing, and rubbing.

No trail of smoke or flame is left by the blast of hot gases issuing from the jet nozzle at the tail.





This cutaway drawing of Howard Hughes' H-4 shows the vast interior that could hold a payload of 60 tons.

Looking Inside the

Howard Hughes' all-plywood flying boat, with eight 3,000-hp. engines, will fly 3,500 miles fully loaded.

Drawings by ERIC SLOANE

UNDER secret construction for almost three years, the world's biggest airplane has just been revealed in all its giant proportions. It's the \$20,000,000 mystery ship on which Howard Hughes has been working, with Henry Kaiser as a partner until a while back, and is now called merely the H-4.

We thought the Superfortress a pretty fair ship for size, with its 141-foot wing



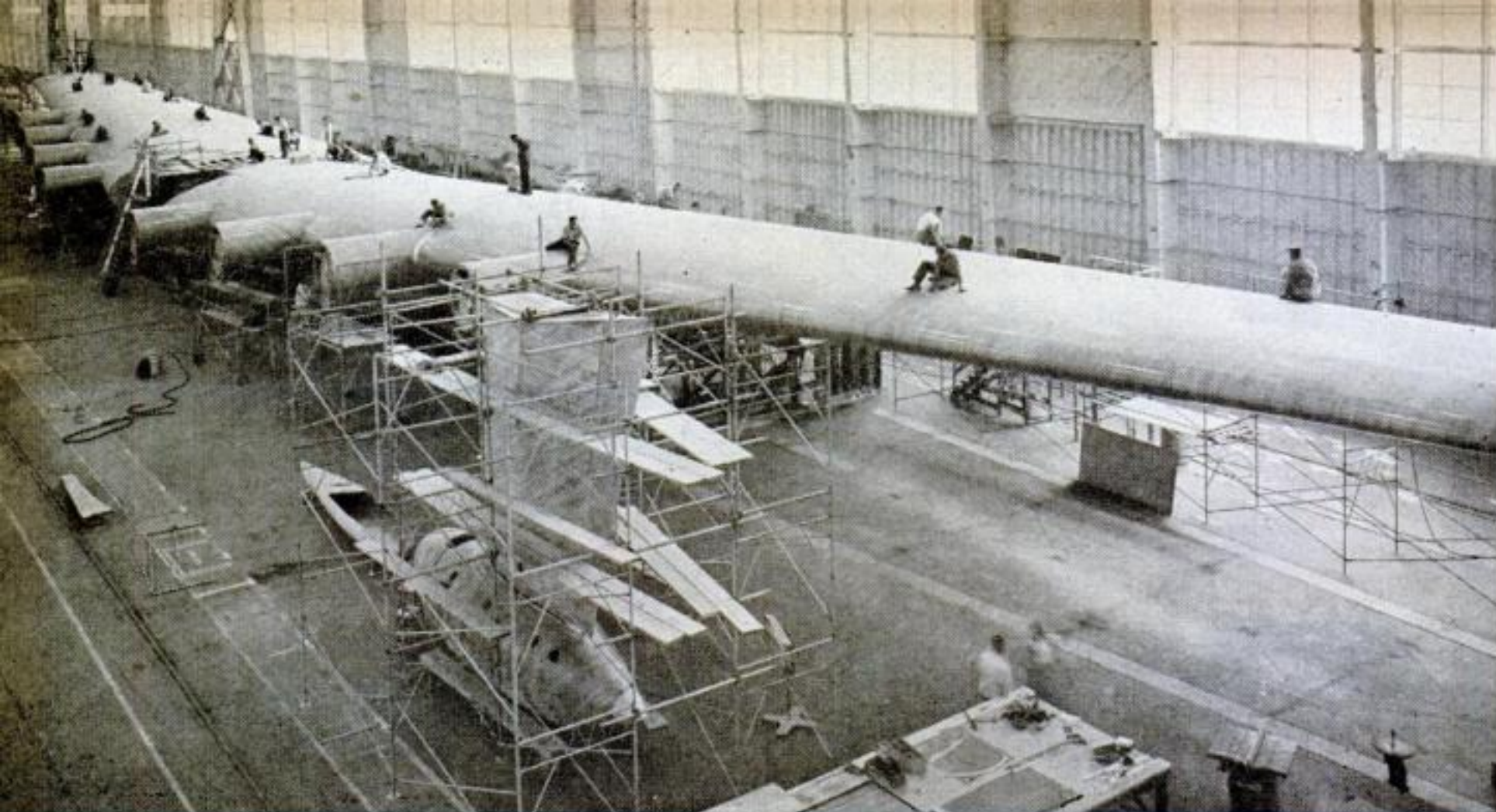
The giant could be a cargo carrier, transport, or hospital ship, and fly nonstop from Honolulu to Tokyo.

World's Largest Plane

span. But the H-4 is big enough to accommodate a Superfort on each wing with room to spare. It has eight engines with a total horsepower of at least 24,000.

The giant's wingspread is 320 feet—longer than a football field. Its hull—it's a flying boat—is 220 feet long and about three stories high. Gross weight will be 400,000 pounds, or 200 tons.

It will be able to carry 650 passengers, with plenty of baggage, across the Atlantic nonstop, or across the Pacific with one stop. Or it can carry a 60-ton Sherman tank, or two medium tanks, or three light tanks. It could take 400 soldiers with five tons of ammunition and equipment across the ocean and bring back 350 wounded with 40 or 50 nurses and doctors. *(Continued)*



WING SPAN is longer than a football field, and thickness at the hull is 13 feet. In this factory scene, expert cabinetmakers have the wing almost finished. One of the H-4's two pontons also is shown.

The H-4 is the fruit of much dreaming and planning by Howard Hughes and Henry Kaiser, followed by a remarkable construction job now nearing completion at Culver City, Calif. They got together in 1942 on the plans for this ship, and started work on it late that year.

The plane is almost entirely constructed of wood strips, glued together. The metal in it, aside from the engines, is negligible. Skin and structural parts are built up of birch and spruce, layer on layer, formed into durable units by modern techniques and the use of new waterproof glues. Thinnest parts of the H-4 are $\frac{3}{64}$ of an inch, built up of three $\frac{1}{64}$ -inch veneers. The thickest part is ten inches, built of 200 veneers $\frac{1}{20}$ of an inch thick. The workers are mostly skilled cabinet-

makers, who know their wood and their glue.

Construction of wings and hull is virtually complete now. The next big job is to move them 22 miles to San Pedro Harbor, where a special graving dock and hangar are being constructed at a cost of \$203,000. The moving job entails the removal of some 30 power lines and two buildings along the route.

EACH PONTON is taller than a man. Mounted on two such floats and the high, deep struts, the wings would clear a two-story building with room to spare.



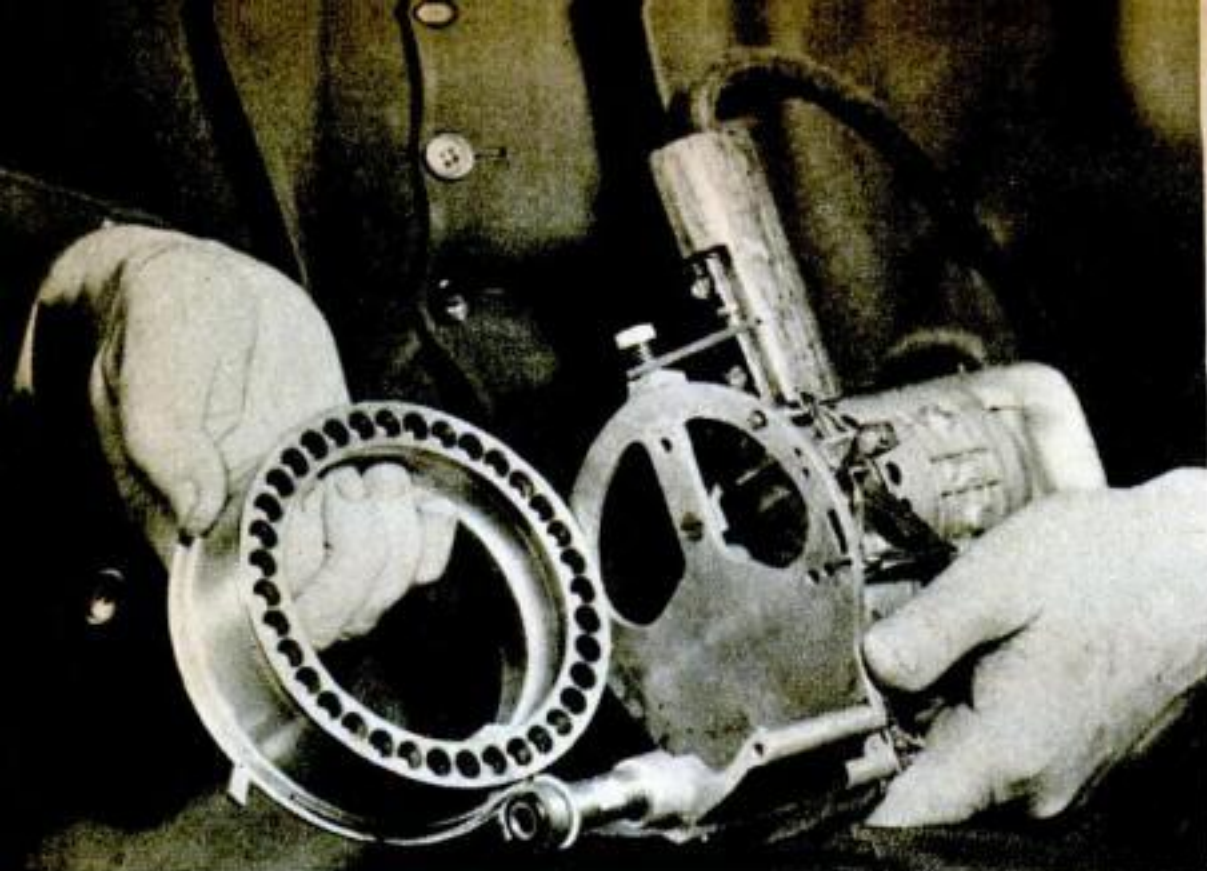
The first flight of the big ship will take place some months hence. When Howard Hughes takes the controls for this flight, he will be sitting 24 feet above the water. The H-4 is not a speedy plane. Its climbing rate is 675 feet per minute, cruising speed 145 miles, ceiling 17,000 feet. Its tanks will hold 14,000 gallons of gasoline. It requires a run of 5,600 feet to obtain a speed of 86 m.p.h. for the take-off, and this takes 67 seconds.

Your Pin-Up

GRUMMAN F7F TIGERCAT NAVY FIGHTER. With twice the power of the famous Hellcat and 50 percent more weight, this twin-engine ship is described as the most powerful fighter-bomber yet produced for the Navy. First Navy fighter to have twin engines, it is powered by two 2,100-hp. Pratt & Whitney Double Wasps that put it in the 425-m.p.h. class and give it a mile-a-minute climb. It can carry two tons of bombs, a full-size marine torpedo, or any desired combination of rockets and bombs. With heavier firepower than either the Hellcat or the Corsair, it can smash even a bomber with a single burst. A two-place model is being made for night fighting. First production goes to the Marines; later, Tigercats will fly from our 45,000-ton carriers of the new Midway class.



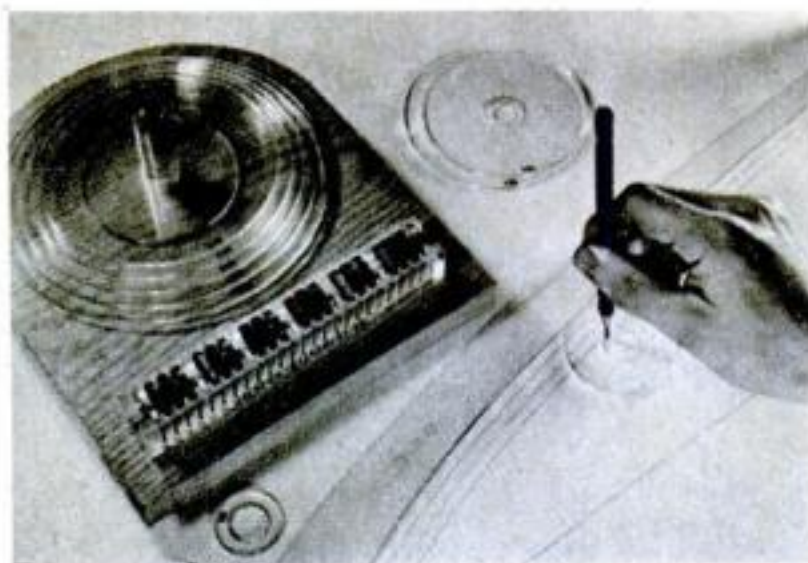
new Tools



AUTOMATIC SCREWDRIVER, electric or air operated, drives all standard or special-head screws into wood or metal to a predetermined depth. The detachable magazine is refilled in a few seconds. Manufacturer is the Reed-Prentice Corp., Worcester, Mass.



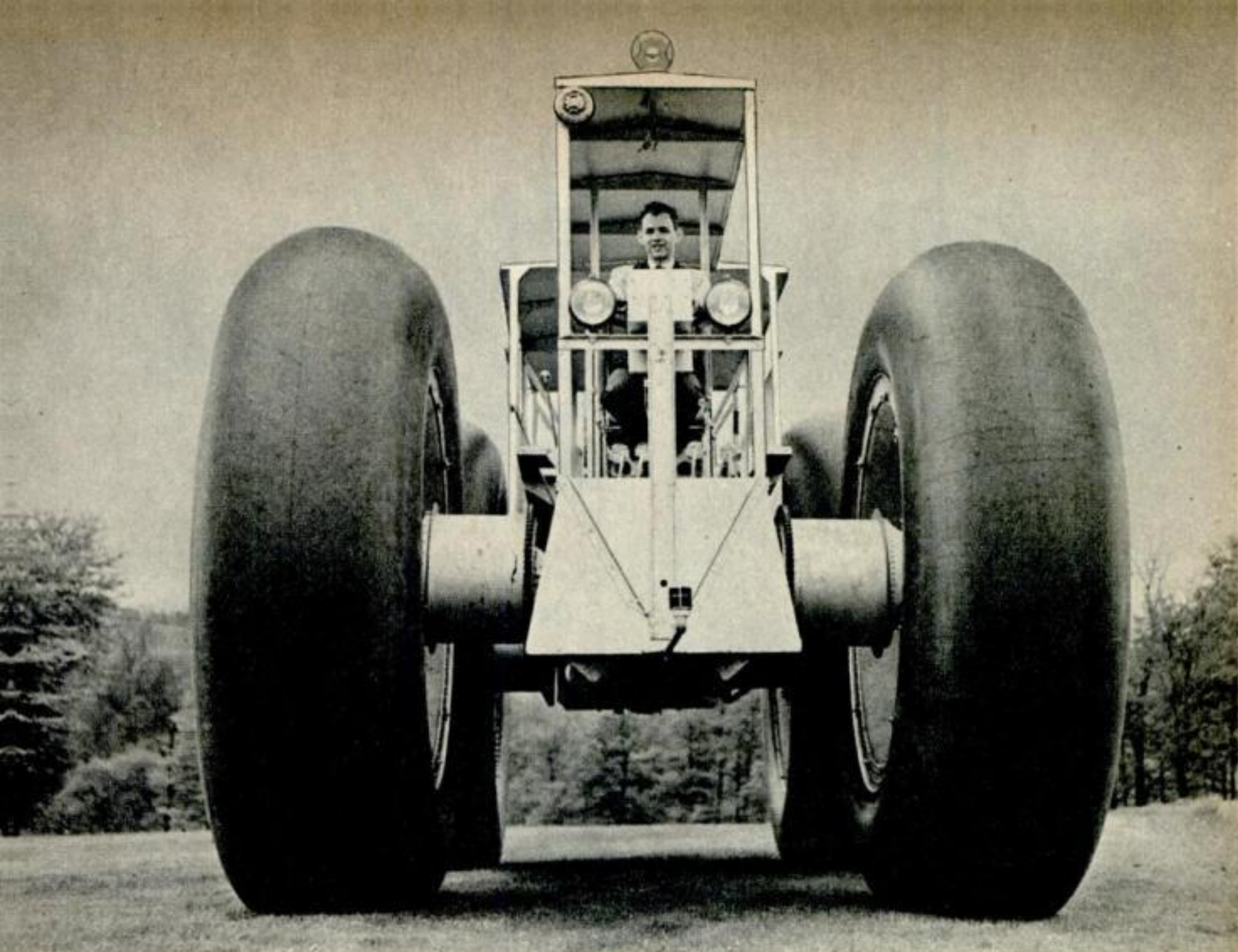
SAWING AND FILING with the drill press are made possible by an attachment developed by H. R. Greene, of South Bend, Ind. Attached in about three minutes, it saws the hardest wood up to an inch thick, very thin plywood, or sheet metal, besides doing various filing jobs on small castings and other work.



DRAFTING AIDS. Plexiglas disks, rolled along the edge of a curved ruler (above), draw parallel lines. The improved lettering triangle below, devised by Llewellyn Price, Fort Washington, Pa., includes fiber strips that raise it above the paper for ink work.



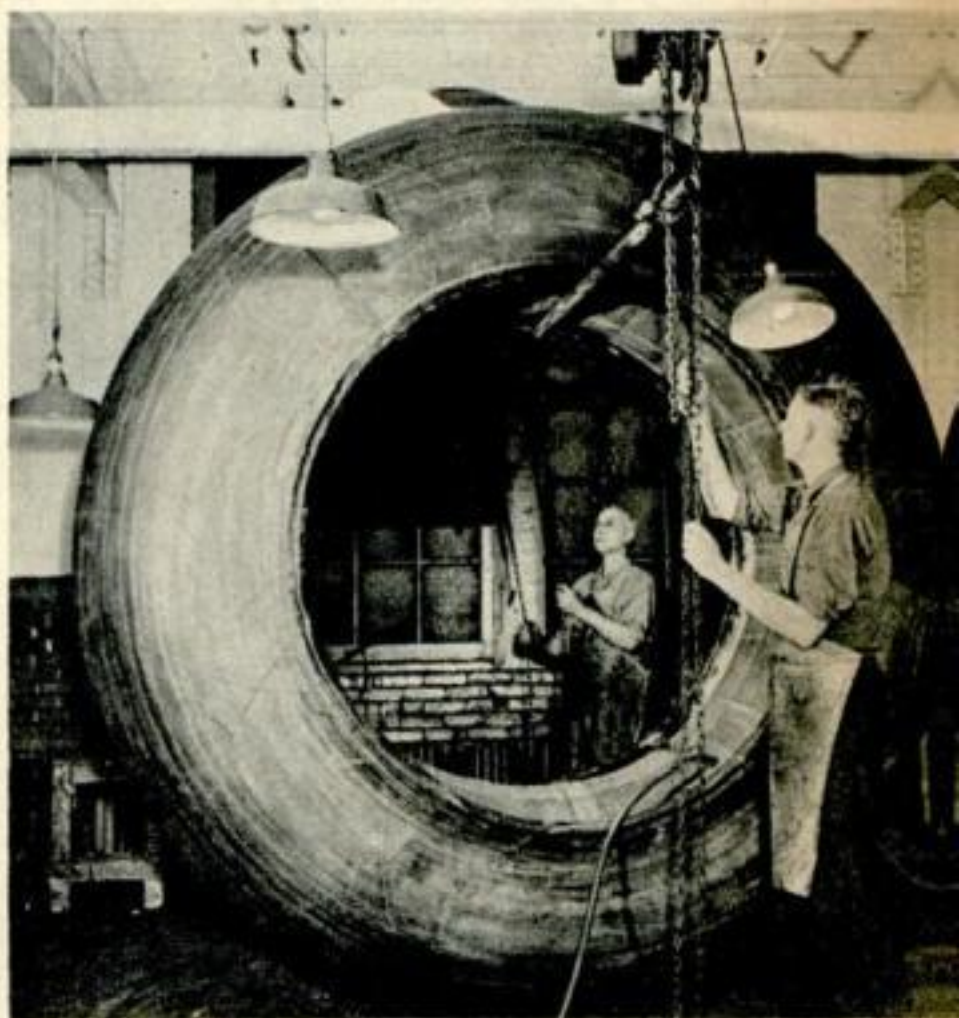
THIS SCALE COUNTS small parts to speed production in war plants. The parts are put in the pan, and the worker reads the number directly from the dial. J. H. Keeney & Co., Chicago, are the makers.



How would you like to change a tire on this "marsh buggy"? These synthetic-rubber doughnuts (size 120 x 33.50) weigh 315 pounds each, their inner tubes 125 pounds. Normal inflation is three or four pounds.

120-Inch Tires Carry Oil Prospectors Through Swamps

ROLLING across sand, swamps, and deep water, "marsh buggies" are taking petroleum hunters to places that could not be reached with boats or beasts of burden. Developed 10 years ago by the Gulf Oil Company for use in the Louisiana bayou country (P.S.M., Mar. '37, p. 40), these strange vehicles became a valuable war aid in the search for oil all around the Gulf of Mexico and the Caribbean. Their 10-foot tires are the tallest ever made by Goodyear.



A giant tire casing begins to take form as Goodyear workmen inflate a shaping bag inside it. Air pressure in the bag molds the rubber casing, which has previously been fabricated on a building drum.

A "marsh buggy" kicks itself along in water at four miles an hour. Air in the big tires and in the hollow, drumlike wheels gives it buoyancy.



Jack Eisner airbrushes the last color onto his three-dimensional paper caricature of President Abraham Lincoln.

He Draws with Scissors

JACK EISNER MAKES FACES IN THREE DIMENSIONS

By DeVERA BERNSOHN

Photographs by ROBERT F. SMITH

JACK EISNER is a perfect cut-up. It's a common belief that artists are frequently that way; but here is Eisner actually making a successful business of it—or, let us say, a profession. Scissors are the backbone of his business, plus glue and paint. With these he creates three-dimensional paper caricatures of men in the news, and dramatic story-telling models for window displays.

In his whimsical studies of famous people, he pokes usually good-natured fun at such celebrities in politics, business, and the professions as Winston Churchill, the Duke



Winston Churchill, with his inevitable Havana, is a natural for paper sculpture. Frank Sinatra, at right, will probably be recognized by teen-age bobby-soxers.





In the Eisner studio, the Duke of Windsor takes a trimming. The ducal nose on the caricature is part of a wooden ball; the clothing is scraps of material glued onto paper; boutonniere, an artificial flower.

of Windsor, Henry Ford, Jimmy Durante, Frank Sinatra, and, incidentally, himself. One exception to his good nature was in his portrayal of the late (?) Herr Schickelgruber, in which he omitted his customary geniality. In fact, the thing was pretty poisonous.

Eisner creates his mischievous caricatures by using paper built out from the background in successive planes, which are bent, curved, and colored with either a bristle brush or airbrush. Thus the artist gets length, breadth, and thickness, and this achievement brings him fairly close to the classification of sculptor. Many of the spoof portraits are life-size heads, while others are made in the form of small busts or full-length statuettes.

They're based on study, too—photographs, or maybe first-hand acquaintance.

After getting the general idea in mind, Eisner goes to work and makes a rough sketch. If he is satisfied with this—and he is not easy to suit—he draws it more carefully on tissue paper. This flimsy is a diagram that shows in detail the base of the profile or full face; also the individual features, all of which have to be cut out separately.

So far, so good. Then the sketch has to be transferred to heavy drawing paper, a simple matter of rubbing the back of the tissue-paper drawing with a heavy pencil. When Eisner has accomplished this, he goes over the lines again with a sharp pencil. Then he leaves a slight margin to allow for the curvature that will be an important part of the finished work.

Now the scissors come into play, prefer-



1 To show how caricatures are made, Eisner (left) uses himself as a model. He sketches face on tracing paper, marking parts to be painted or cut out and glued onto the base in separate planes.

2 Cutting out the sketch, after it has been transferred to drawing paper. Allowance is made so that when cut-out is glued to cardboard, the facial bulge will be permanent. Trimmings are put to use.



3 Here the paper sculptor glues the nose onto the face. Cheeks will then be applied in the same manner. To keep such features from collapsing as adhesive dries, small cardboard props are inserted.

ably the type used by barbers—with the finger rest. Eisner cuts out the base drawing of the face, leaving a tab about two by four inches on each side. Later he folds these face tabs back and glues them onto a piece of heavy cardboard. Thus he rigidly fixes the curve of the paper, and helps to give a lifelike appearance to the caricature.

Features that Eisner wants to emphasize are transferred to another sheet of paper from the finished sketch and cut out separately. But before gluing these parts in place, he folds and curves the paper, rolling it over an orange manicure stick to achieve



4 Approaching completion, the paper caricature is airbrushed with natural skin colors, and the hair, eyebrows, and lips are painted on. Coloring seconds modeling to accent facial characteristics.

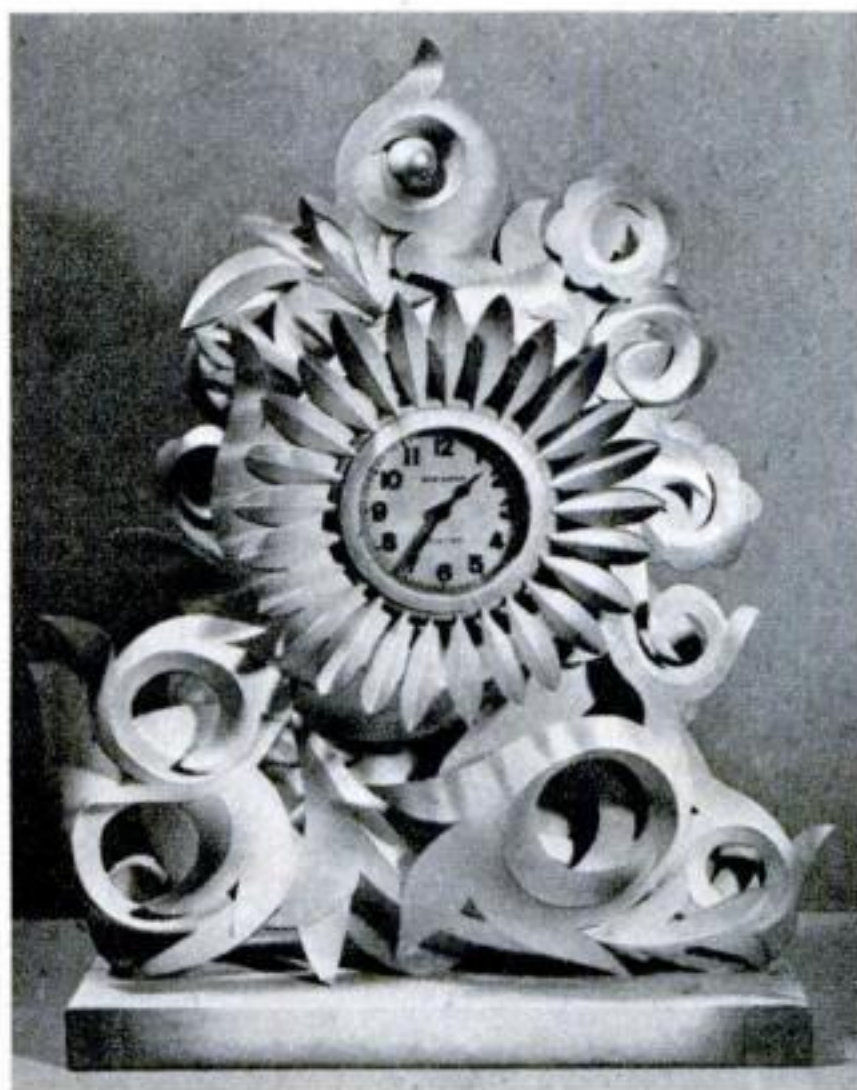
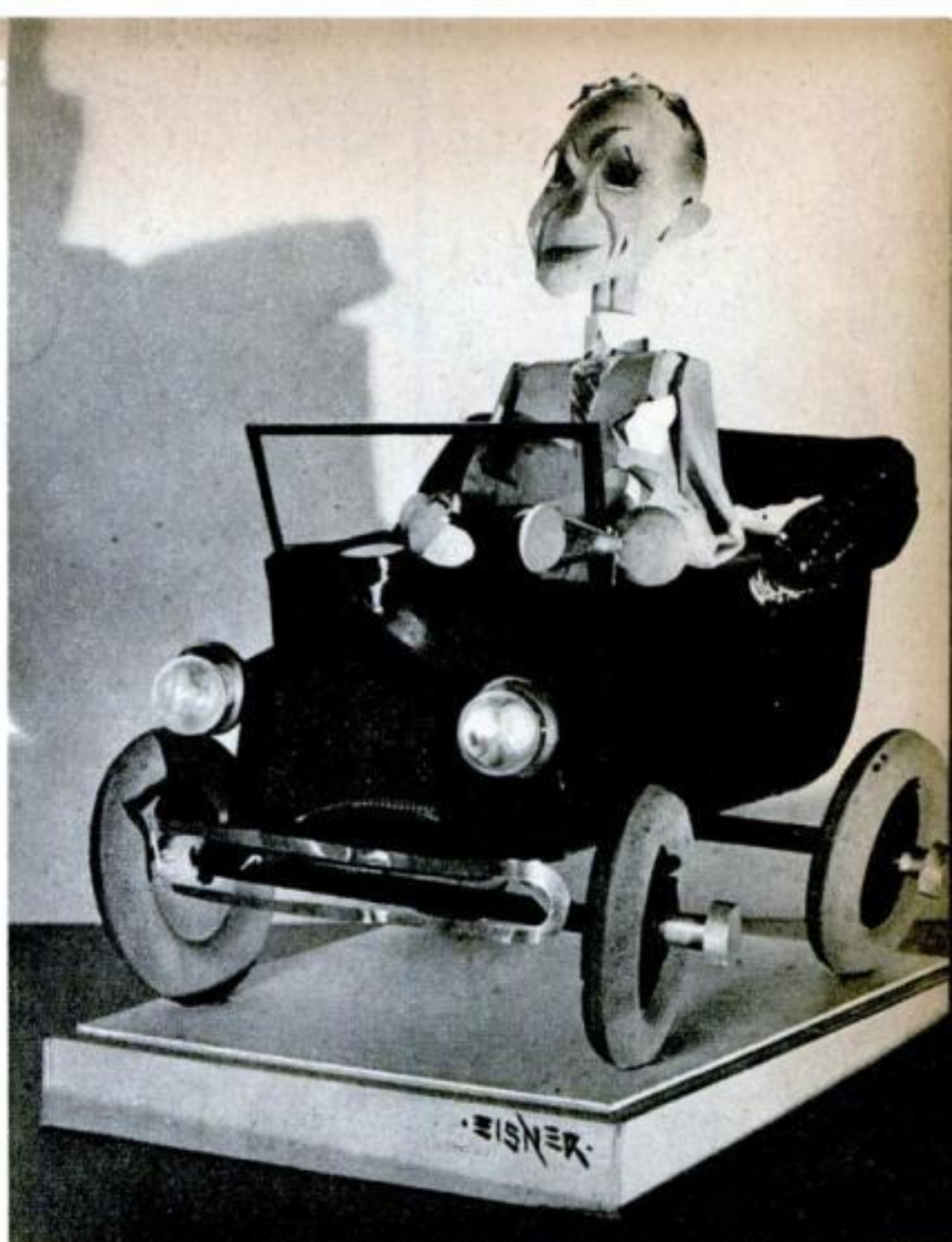
the right degree of roundness. Then the edges of the features are stuck to the base. Eyebrow tweezers help in handling tiny parts, and sometimes a magnifying glass becomes necessary. Small cardboard props, temporarily slipped under facial parts, keep the features from falling flat while the glue is drying. Finally Eisner paints on the hair and lips with water colors and airbrushes skin tones onto the virtually completed bit of sculpture.

The artist has a good deal of fun in adapting other materials than paper to his caricatures. An automobile taillight pinch-hits



5 The finished self-caricature by Eisner proves that he can take it as well as dish it out. After giving the model a final scissoring, all that is left for him to do is start a libel suit against himself.

At right is Eisner's conception of Henry Ford driving one of his early T-model cars. The picture below shows how paper sculpture has been used for purely decorative ends. What looks like carving is paper that has been cut out, curved, and glued onto a wooden background. Gilt applied by airbrush adds a fancy touch.



for a diamond stickpin, the tip of a shoe tree for a nose, a collar button for a motor-car horn. These are only a few of the smart subterfuges that have helped to make these caricatures what they are. In one of Joe

Louis, a particularly apt touch is the use of table-tennis balls to simulate the prize fighter's bulging shoulder muscles, biceps, and boxing gloves.

Eisner's home workshop is at Woodmere, Long Island, an hour or so distant from New York. He'd better not leave it unlocked when any small boys are around, because it contains the most wonderful collection of junk that a kid could imagine—drawers of toys, bits of yarn and wire, and paper of all sorts and colors. And all of it is grist to the mill.

Branching out from caricature into other fields, Eisner devised a way to make paper look like ornately carved wood, and Fifth Avenue merchants have made use of his work in window displays. He has also made decorations for a debutante's coming-out party, toys and books for children, and miniature buildings done to exact scale.

One of Eisner's window dressings consisted of chairs and other props made entirely of white paper to set off the very latest models of women's dark clothing. It is his firm belief that there are almost unlimited possibilities in the use of flat materials adapted to three-dimensional uses. He gives as examples preliminary studies for sheet metal designs, scale models for architectural use, stage decorations, and television-program settings.



Colorful projects like these are fashioned from cornhusks—a return to an art of our grandmothers' day.

Craftwork from the Cornfield

Photographs by WILLIAM W. MORRIS

TO OUR pioneer settlers, a good corn crop always meant more than food. The husks, made into everything from mats for the floors to mattresses for the beds, were an important part of the harvest. Now that corn is at the height of its season, you may want to try your hand at this craft.

The husks come in layers—the inner fine and soft, the outer coarse and strong. Coarse husks make good floor mats and brooms; soft ones are fine for table mats, bags, lapel ornaments, and the like.

Inner husks of mature field corn turn almost white when dry and can be dyed with ordinary cloth dyes. Boiling is necessary only if they must withstand washing. Husks of sweet corn require drying, but they remain green and don't dye readily. For interesting cornhusk projects turn to page 149.



POPULAR SCIENCE

New Wing Float for a Mariner! The Lift Truck Lends a Hand

THIS handy little motor truck, with its elevator fitting on the front, hoists a new float to be attached under the high wing of a Martin Mariner. One of the mechanics rides up on the open-air lift, ready to make the necessary connections. The long-range Navy patrol bomber is getting its new boot at the Norfolk (Va.) Naval Air Station.

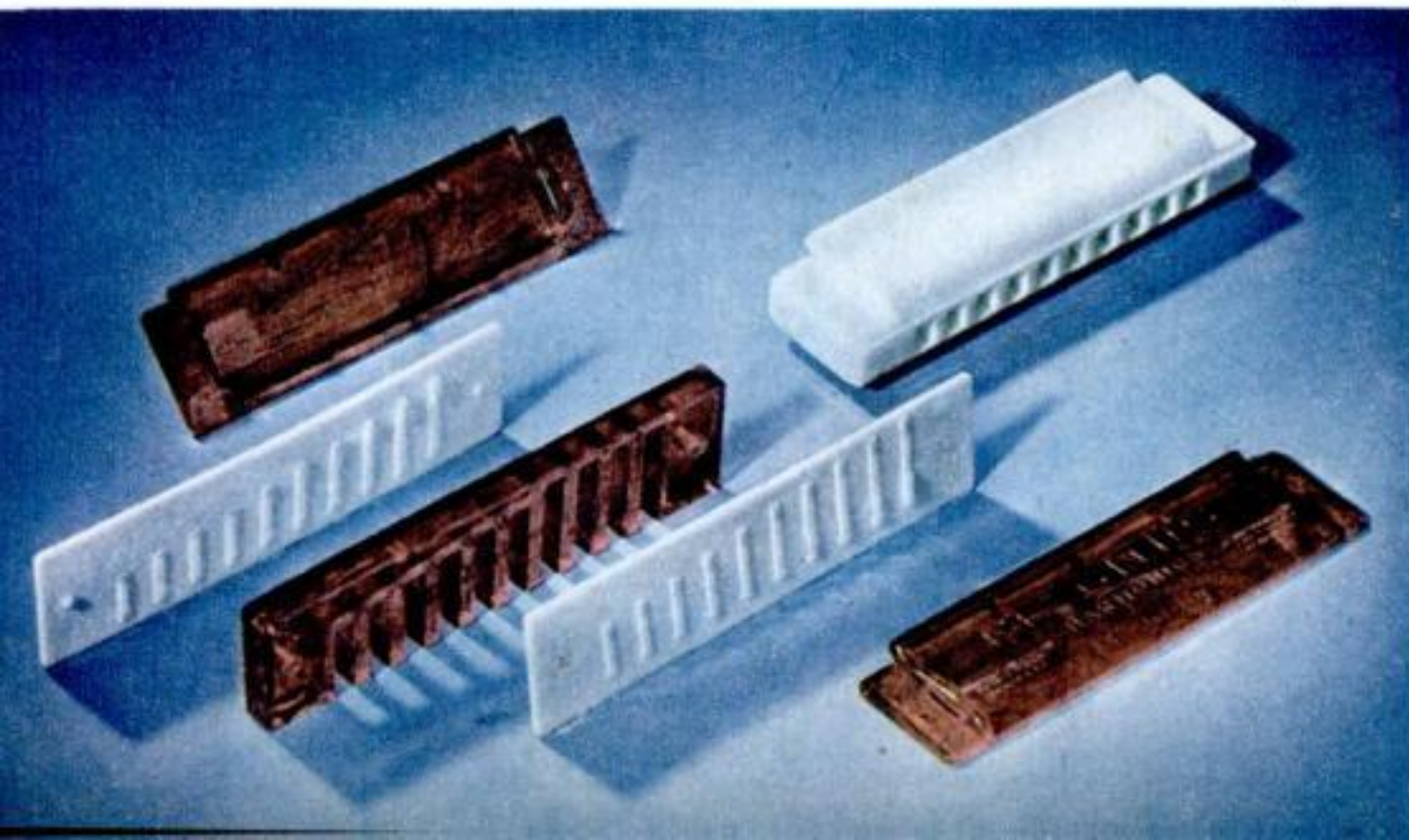


Postwar Plastic Harmonica Has Five Parts Instead of 80

A NEW plastic harmonica, composed of five parts (see photo) as compared with 80 parts in the old-type instrument, makes possible the first large-scale production of harmonicas in America. Invented by Finn H. Magnus and molded from Bakelite polystyrene, the new mouth

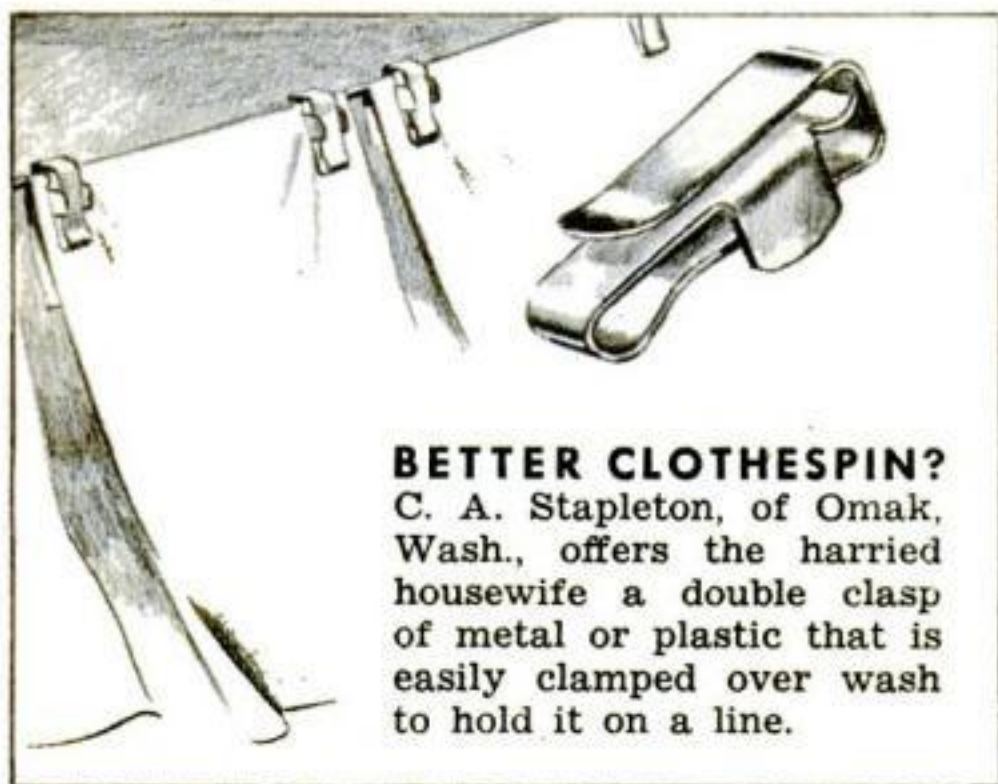
organ is sanitary, sturdy, and inexpensive to make. It retains its tone under all climatic conditions.

In the conventional harmonica, the most difficult parts to make are the delicate reeds and the reed plates. The reeds are punch-pressed from flat brass stock and hand-ground to size. Then each reed has to be hand-riveted to the plate. In the plastic harmonica, the reed plate is molded in a single operation and contains all the reeds as integral parts of the plate. Complete assembly of the five parts, by "welding" with a hand press, takes only five seconds to accomplish.

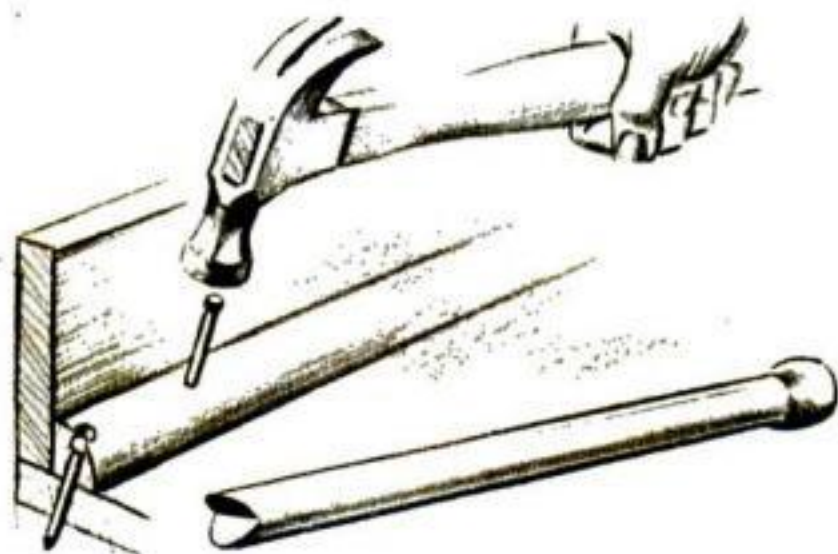




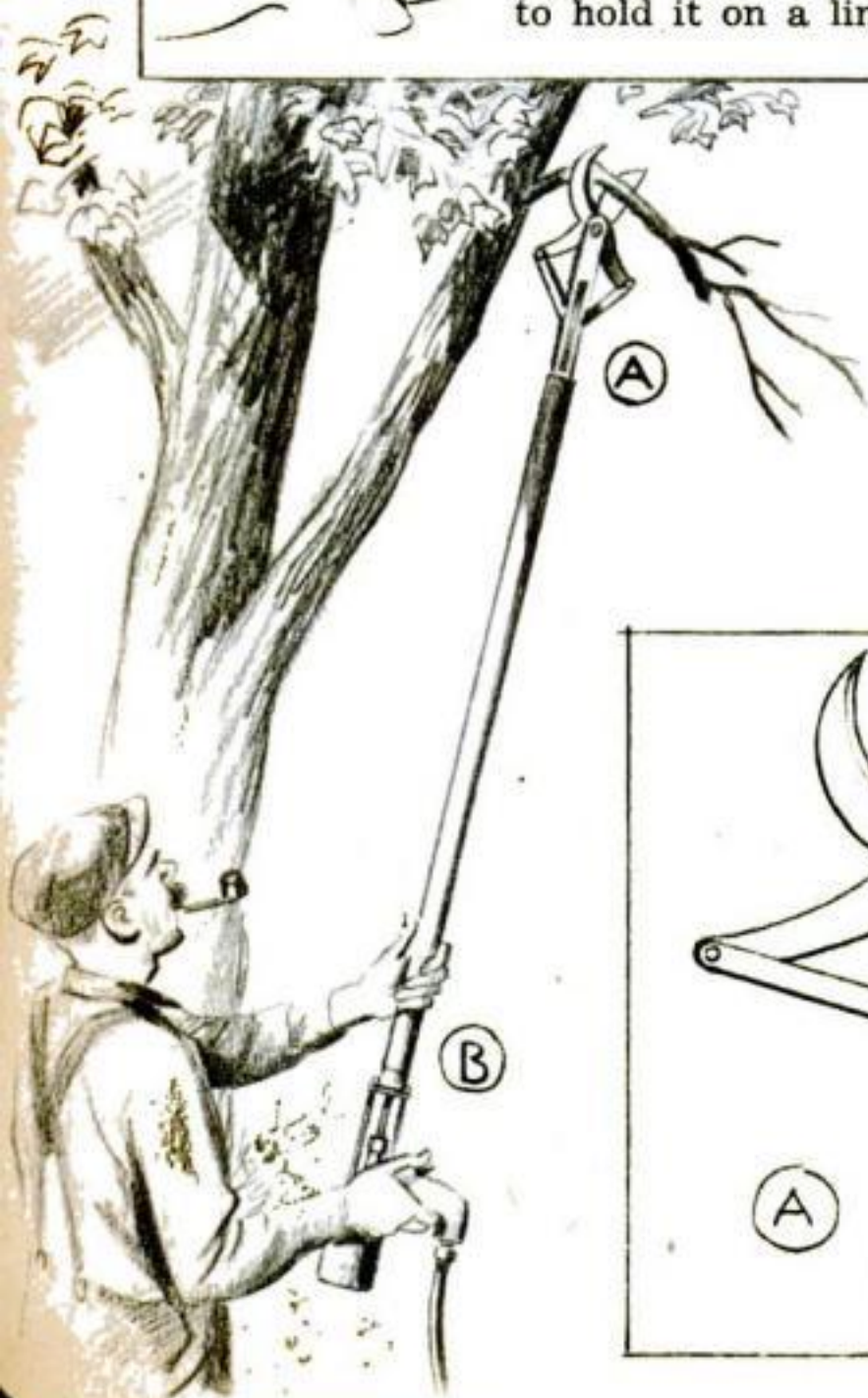
EARRINGS of wood, plastic, and other nonmetallic materials are held comfortably on the ear lobes by a method invented by Cheri Rich, of New York, N. Y. A strip of adhesive tape, threaded under a bar on the inside of each earring, is stuck to the lobe of the ear. This eliminates the need for a spring clip or screw to hold the ornament in place.



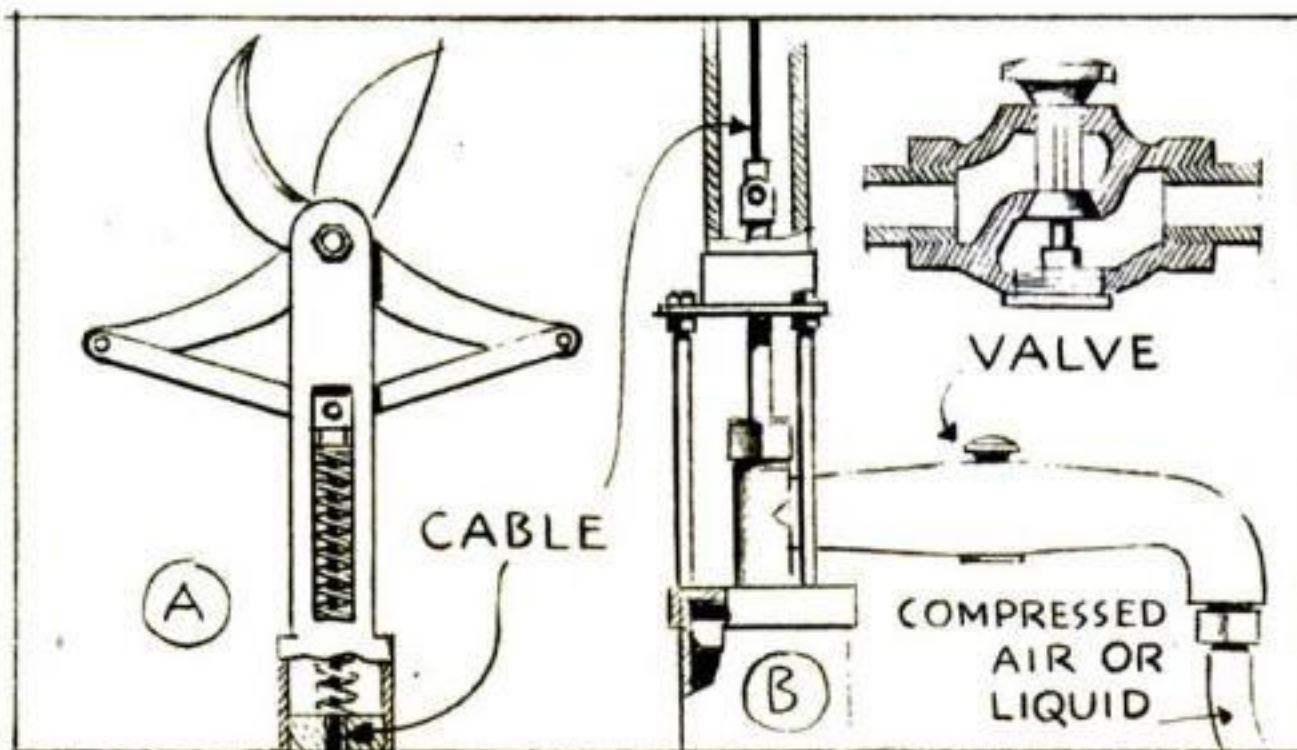
BETTER CLOTHESPIN? C. A. Stapleton, of Omak, Wash., offers the harried housewife a double clasp of metal or plastic that is easily clamped over wash to hold it on a line.



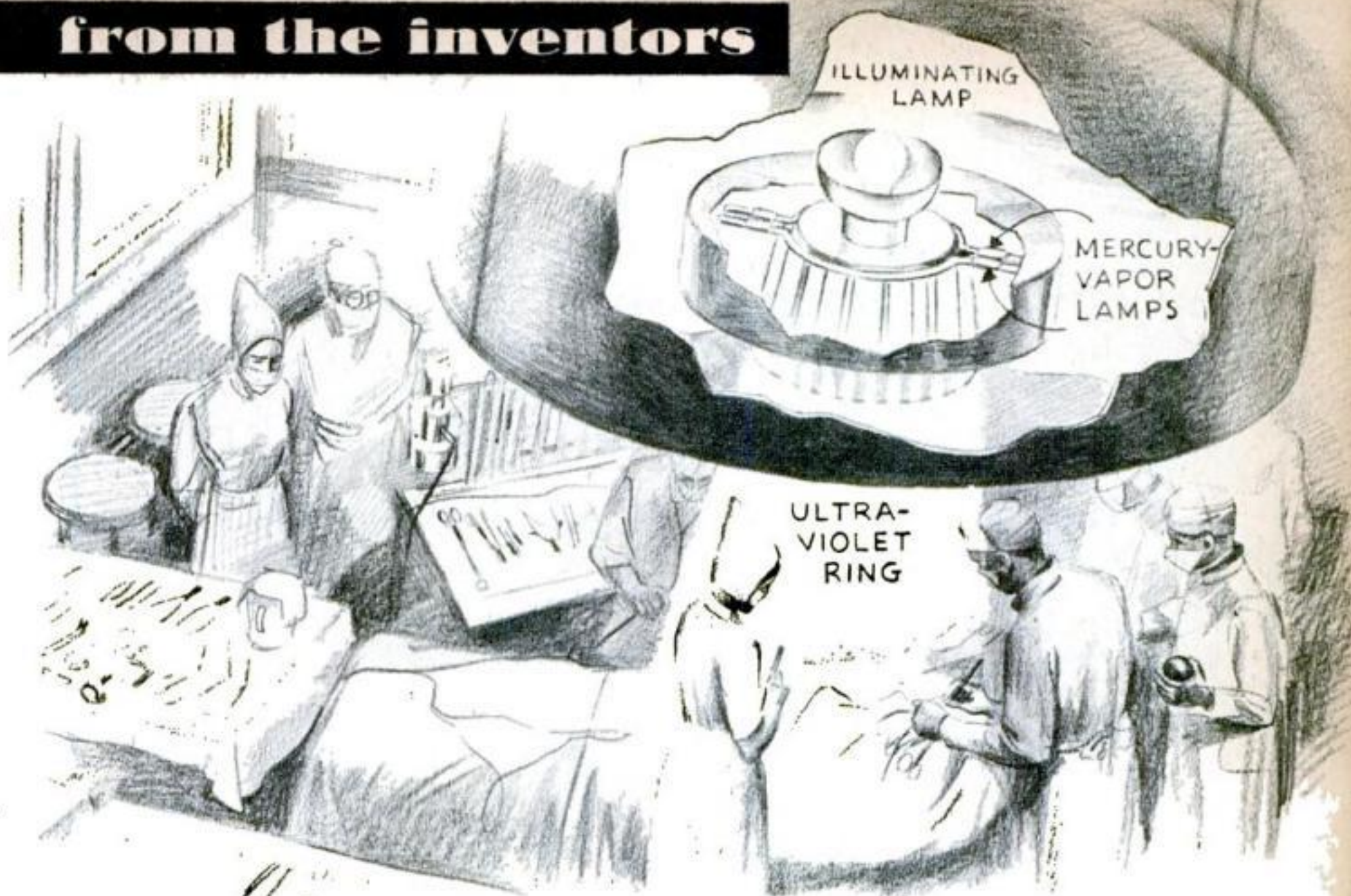
NONSPLITTING NAIL has a V-shaped notch at the end instead of a point. When it is driven into wood, it cuts through the fibers instead of parting them. Inventor is E. J. Gair, Snyder, N. Y.



POWERED PRUNING SHEARS. Compressed air or liquid does all the hard work of tree pruning with these shears, designed by Charles J. Johnson, of Sacramento, Calif. Pressure fed to the tool through a flexible hose pushes down a piston in the butt of the handle. This pulls a cable extending through the hollow pole to bring the blades of the shears together. When the pressure is released, a spring opens the blades for the next cut.



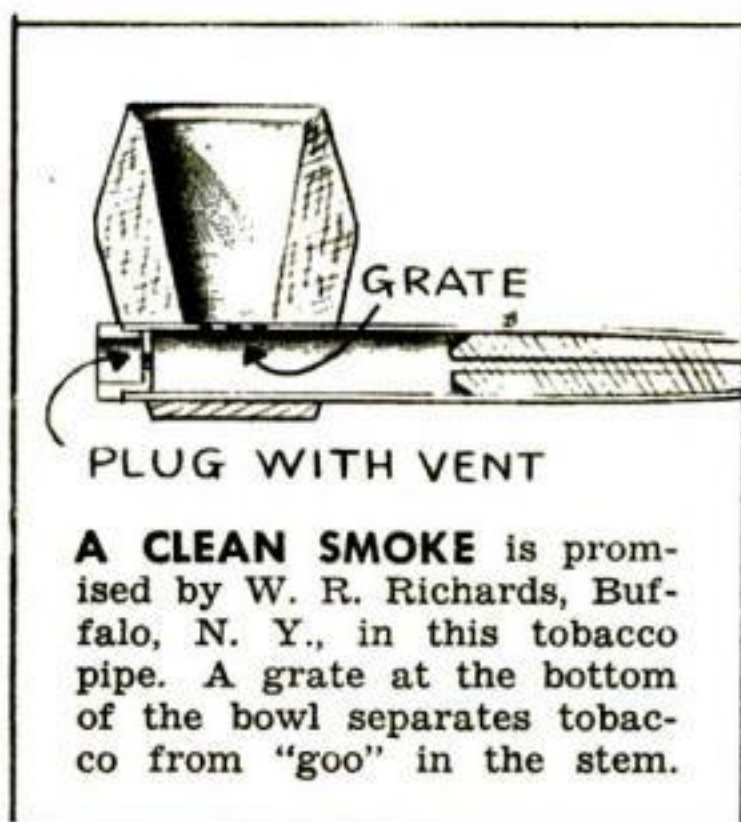
from the inventors



GERMS CAN'T PASS the magic curtain of ultraviolet radiation thrown around an operating table by the lamp shown above. Besides providing light for the surgeon and his assistants, the lamp casts a hollow cone of germ-killing rays around the working area. This prevents infection of

the wound without subjecting the exposed internal tissues to the ultraviolet radiation, which might be harmful if too long continued. The curtain of light is produced by an arrangement of reflecting surfaces. J. W. Kolbert and F. G. A. Haegle, of Slough, England, are the inventors.

PAGE ROBIN HOOD! The famous archer of Sherwood Forest might have chalked up an even better score if he had used this sighting device originated by Oliver H. Brown, of Waupaca, Wis. Adjustable horizontally and vertically, it is clamped firmly to the bow's upper limb.



A CLEAN SMOKE is promised by W. R. Richards, Buffalo, N. Y., in this tobacco pipe. A grate at the bottom of the bowl separates tobacco from "goo" in the stem.



POPULAR SCIENCE TAKES YOU INTO A

Colonial Woodworking Shop

Tools of 200 Years Ago Create Fine Furniture

LIKE a page out of a story book, suddenly come to life, is the scene that greets the surprised visitor who enters The Ayscough Shop in restored and reconstructed Williamsburg, Va. Nowhere else in the world, perhaps, could one see another cabinetmaker's shop like this. Workmen wearing knee breeches, white stockings, and shoes with silver buckles are busily engaged in fashioning beautiful articles out of wood, and the tools they ply with infinite skill are as ancient as their costumes. They are not permitted, in fact, to use any tool or device that was not actually employed when Williamsburg flourished as capital of colonial Virginia.

This is a unique scene in 1945, but there is a reason for it. "That the Future May Learn from the Past," is the motto of Colonial Williamsburg, Inc., the organization that is [*\(Continued on page 110\)*](#)



CABINETMAKER

of the eighteenth century used the spoke shave to produce much of his delicate handwork. The chair being finished here is of the type used by wealthy residents of Williamsburg even long before the Revolutionary War.

Photographs by
WILLIAM W. MORRIS



MAHOGANY TEA CADDY, all handmade and exactly like the tea chests in vogue in colonial times, is delivered to a "customer" by Joseph Kobelbauer, master cabinet-maker of The Ayscough Shop. Mahogany was the favorite wood of early craftsmen.



THE OLD-TIME LATHE, used for turning, grinding, polishing, etc., was made of heavy timbers and other pieces, and was a difficult device to adjust. The tool rest, a strip of iron fastened to sturdy wooden pieces, could be moved only by loosening a wooden wedge, then sliding the assembly into the desired position and tightening the wedge again. Above, the cabinetmaker adjusts the piece on which the tool rest is fixed. Below, he inserts the wedge to secure the piece.



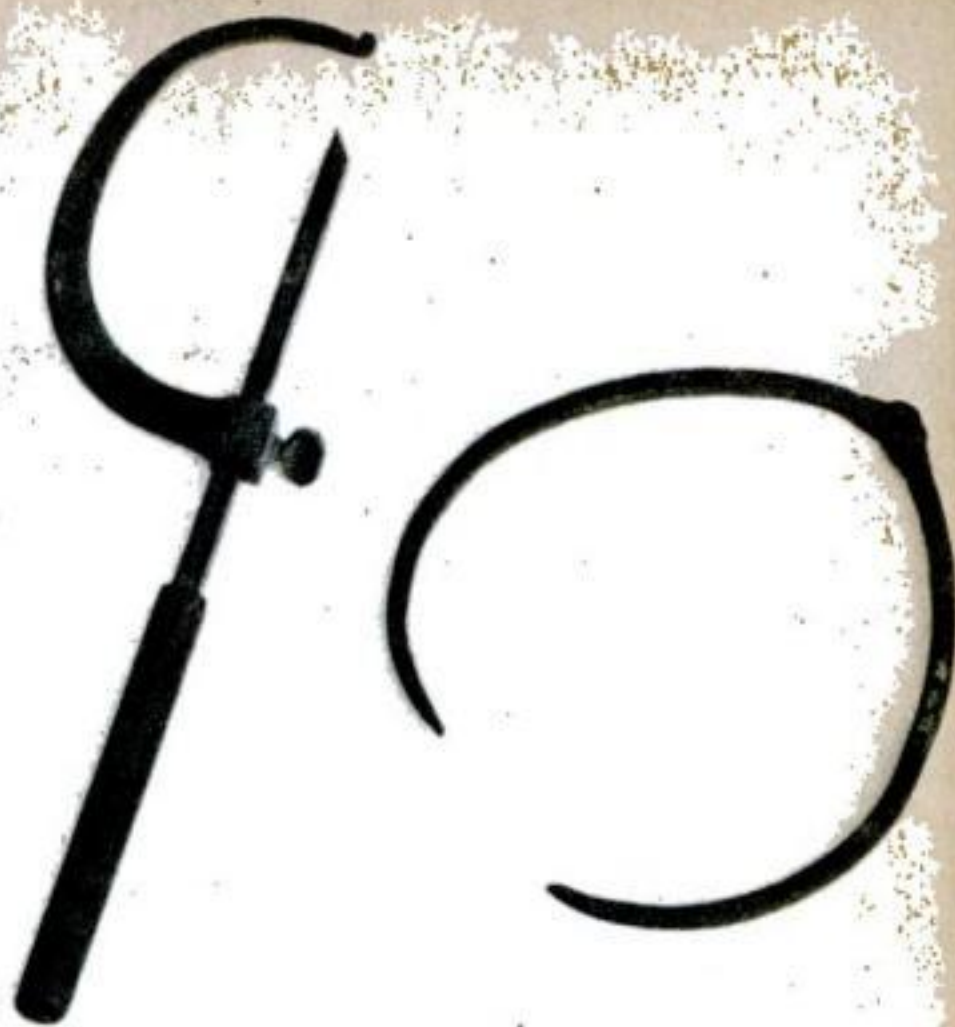
re-creating a whole city that we know only from our history books.

The cabinetmaker was an important man in colonial times. He ranked with the architect. That was the day of Thomas Chippendale, himself a master craftsman of England. The cabinetmakers in colonial Williamsburg turned out furniture that ranked with his. No doubt they used his exquisite designs, as many others of the period did. To see now the crude implements with which these artisans worked is to have greater admiration for the cabinetmakers and their accomplishments, and to prize more highly the few specimens of their handiwork still in existence.

As one enters the Williamsburg cabinet shop, the whole scene gives the feeling of having stepped across the threshold into another world. Dominating the room is a great, wooden wheel, six feet high, with a crank at the hub and a rope belt passing around its rim and over a pulley on a crude wooden lathe. That is the nearest thing to machinery that one sees. The wheel is turned by manpower, and we are told this was usually the task of the apprentice.

Hand tools of the period hang on the walls and, like the lathe and its wheel, all are actual relics of the eighteenth century, gathered from far and wide through many months of painstaking search. Their handles have the unmistakable polish given them by the hands of workers long since passed on. With the dust of the years wiped off, they are in use again, turning out things of beauty, to the same designs in fact as in the old days—for only furniture of the colonial period is produced in the shop.

The workbench, too, is one that was used 150 years ago. This was found well preserved in an old barn. Its surface shows many a mark of the tool, and through its top is the hole in which the ancient type of bench clamp fitted, driven down by a hammer to hold the work, or "stuff" as they called it then. One of these clamps also has been recovered and is in use. It works well enough, although it is a far cry from the efficient bench vises of today.



TOOLS FOR WOOD TURNING. Two centuries ago the tools used were not much different from those of today, except that they were cruder and heavier. Calipers were much like those now in use.

Wood-framed saws of great variety are prominent among the hand tools. They were the mainstay of the old-time worker, from the small scroll saw of quaint design to the much larger one used to saw veneers by hand. The scroll saw's blade was tightened by twisting a cord with a stick, that of the veneer saw by driving a wooden wedge that stretched it taut. The hand-saw of today, of course, is not in evidence, but something like it did exist in colonial times. It was a heavy and coarse-toothed saw, rather a tool of the carpenter than of the cabinetmaker.

Joseph Kobelbauer, master cabinetmaker of the present-day Williamsburg shop, is a worthy successor to the colonial artisans, and exhibits the same kind of skill with the tools that they must have possessed. His father and grandfather were cabinetmakers too, and he served his apprenticeship just as did the boys of colonial Williamsburg.

Love of his job shows in Mr. Kobelbauer's ruddy face as he plies the tools, one after another, on a piece of raw mahogany. Selecting one of the many block planes from a shelf, he shapes a molding along the edge. The planes are numerous, for we must remember that the old-time cabinetmaker *(Continued on page 115)*

PREFACE.

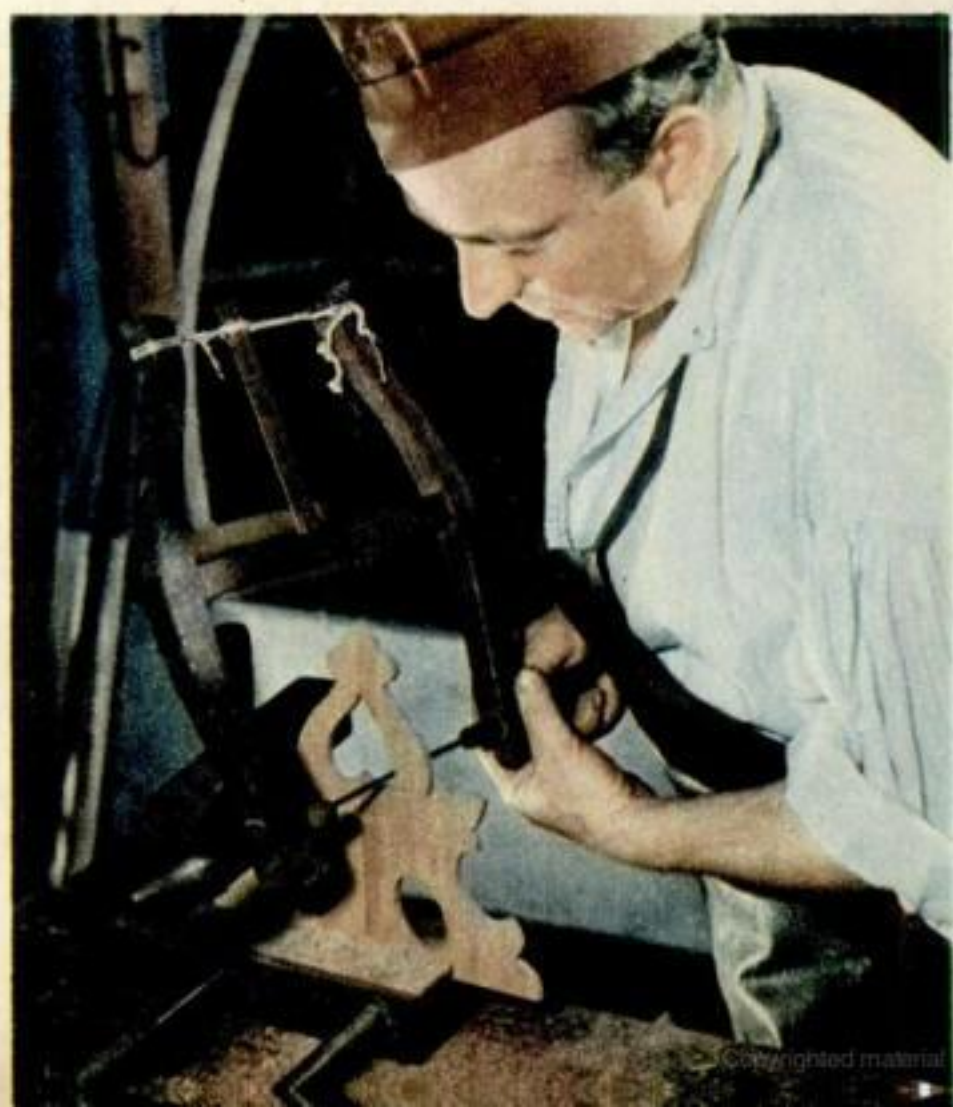
I See no more Reason, why the Sordidness of some Workmen, should be the cause of contempt upon Manual Operations, than that the excellent Invention of a Mill should be dispis'd, because a blind Horse draws in it. And tho' the Mechanicks be, by some, accounted Ignoble and Scandalous? yet it is very well known, that many Gentlemen in this Nation, of good Rank and high Quality, are conversant in Handy-Works: And o-ther Nations exceed us in numbers of such. How pleasant and healthy this their Diver-sion is, their Minds and Bodies find; and how Harmless and Honest, all sober men may judge?

That Geometry, Astronomy, Per-spective, Musick, Na- ch-

EARLY HANDBOOK of woodworking verified the methods used in The Ayscough Shop. This is the first page of the preface of "Mechanick Exercises," by Joseph Moxon, as published in 1703.



WILLIAMSBURG SAWS were of odd shapes and sizes—mostly narrow blades held taut by one means or another in rectangular wooden frames. The cabinetmaker of 200 years ago made his own veneers, as above, with a crude saw whose blade was tightened by means of a wedge driven through a slot in front of the handle. The pit saw, shown in the drawing at the left, was so named because, in sawing boards from logs, one man would stand in a pit to pull the saw downward while his teammate stood on top of the log to draw it back. The saw used for cutting dadoes (lower left) had half of its teeth raked in one direction and half in the other to permit a push-pull operation. The blade of the double-handled scroll saw (below) was strained by twisting the cord with a stick until it was tight.



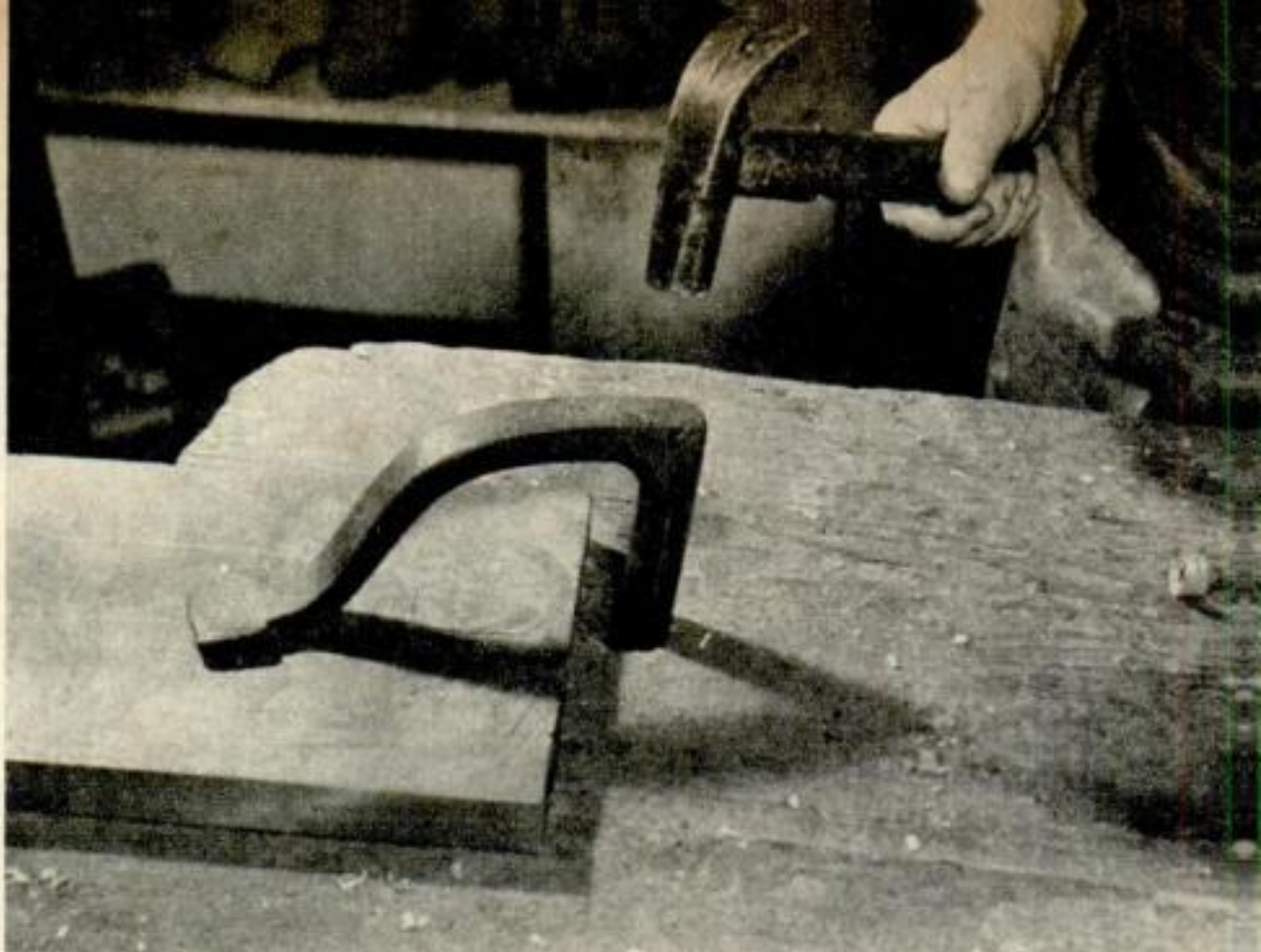


ONE MANPOWER is the force used to turn this lathe, of which close-up pictures are shown on page 110. The apprentice usually got the job of turning the "great wheel," while the skilled craftsman employed the tools. A rope or other form of belt turns the driving pulley attached to the mandrel. The tailstock spindle of the lathe is adjustable by turning the handle.

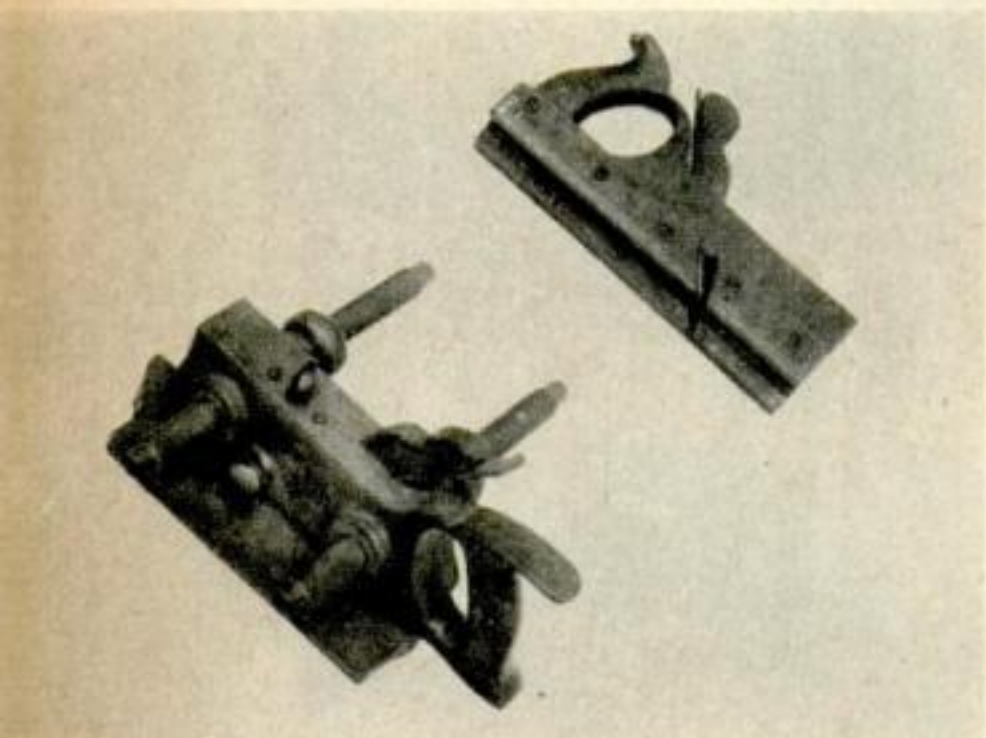
WOODEN BRACE. The brace being used below is about 200 years old but still is serviceable. Made of wood, it has brass bindings. Note the bench clamp holding the work. This is the forerunner of the vise.

MALLET. The old mallet seen below plainly shows its years of service. Master cabinet-makers made excellent joints, and the mallet and chisel were much-used tools. This mallet is again seeing service at The Ayscough Shop.





"HOLDFAST." The efficiency of the old-time bench clamp, also called the "holdfast," is demonstrated at The Ayscough Shop in Williamsburg. Inserted in a hole in the bench, it is driven down with a hammer, its clamping end holding the work firmly. The hammer also is of the eighteenth-century period.



TONGUE AND GROOVE. The upper plane made the tongue and the lower one the groove for cabinetwork more than 200 years ago. The latter, also known as the "plow," now has wooden screws for moving the "fence" nearer to or farther from the blade so that the rabbet will be cut exactly.



BRACE AND BIT. The all-wood brace at the far left dates from the sixteenth century and was the only one the colonial cabinetmaker had until the brass-bound model was evolved. Late in the eighteenth century the steel brace came into existence. The square-shanked bits (above) fit snugly into four-squared sockets of the braces. The other tools shown are a carving chisel, a dado saw, and a screwdriver.



A PAGE FROM MOXON'S BOOK

A. Joiner's Bench with bench screw, having (b) catch, (d) hold-fast, and (e) mawl (a mallet).

B. (1) Fore plane, (2) "joynter," (3) strike block, (4) smoothing plane, (5) rabbet plane, (6) plow.

C. (1 to 5) chisels and (6) gouge.

D. Try square.

E. Compass saw.

F. Bevel.

G. Gauge.

H. Brace and bit called also a "piercer."

I. "Gimblet," or "wimble."

K. Auger.

L. Hatchet.

M. Pit saw.

N. Whipsaw.

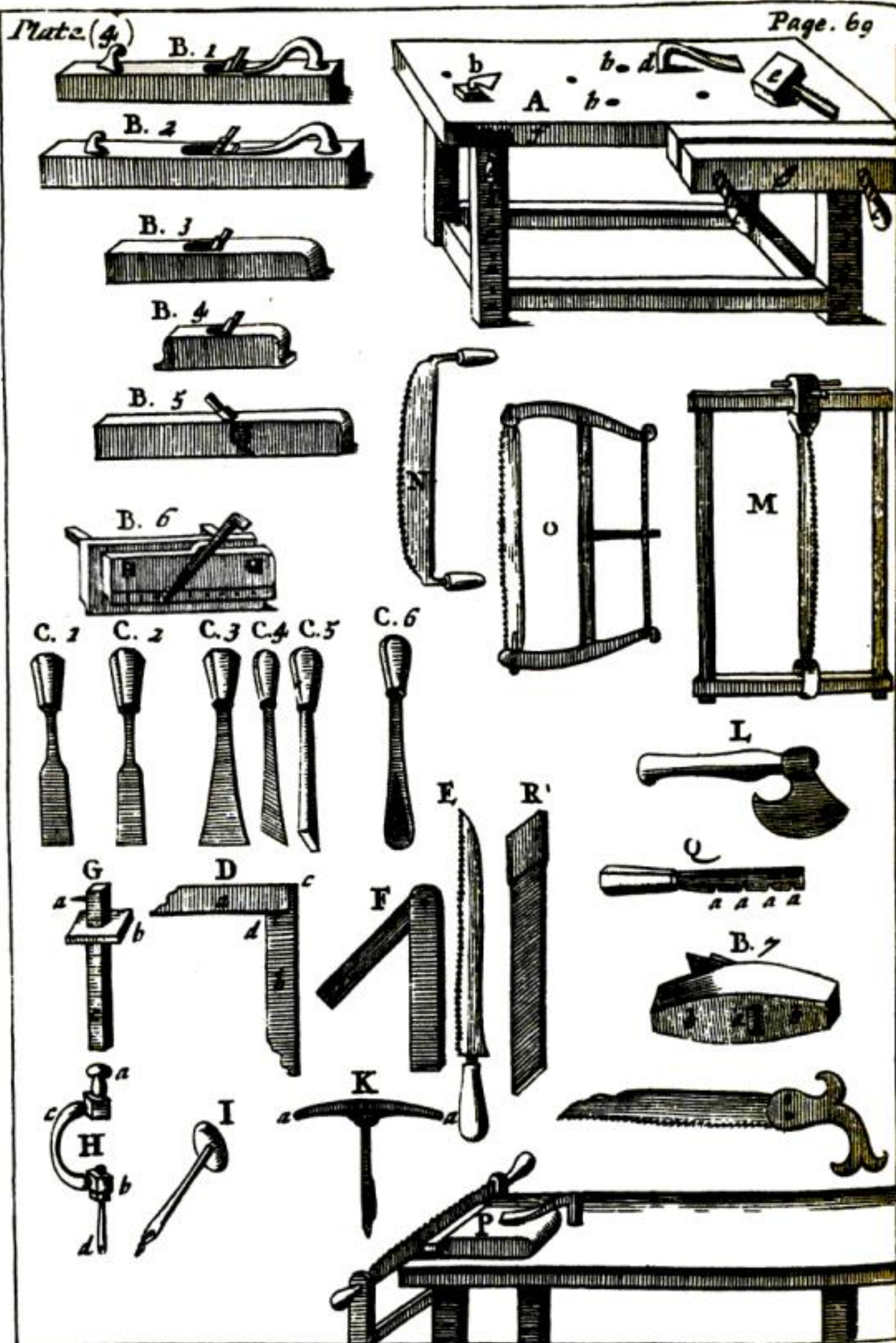
O. Bow saw.

P. Saw in clamp for filing

Q. "Saw wrest," for setting saw teeth.

R. Miter square.

Handsaw, not lettered, is shown above the bench in the lower right corner.



could not order a length of ogee molding from a mill, or anything else but rough, hand-sawed lumber. Whatever shape was desired had to be hewed out by hand from beginning to end. And these planes are crude ones, just a block of wood into which the blade must be adjusted and fixed by a wooden wedge.

The braces and bits are curious when compared with those of today, though they were fairly efficient for their purposes. The braces are of wood, cut roughly to the shape of the modern type. There is a free-turning knob at the top and a

square hole at the bottom to receive the bit shank. The grip for the right hand does not turn. This type of brace dates back to the sixteenth century and was all that the colonial cabinetmaker had. About the time when Williamsburg's period of glory ended, 1799, the first steel braces appeared. In the meanwhile, somebody also thought of securing the bit in the brace with a screw. The standard boring bit of the time had no threads on the center pin and no spirals on the shank. It had a blade on one side of the end for cutting around the periphery and one on the other



ANCIENT PLANES were much like those of today, but the blades had to be tightened by removable wooden wedges. Above, the cabinetmaker uses the long trying plane, finishing a piece of wood with exactness. Below, he manipulates a tiny plane which has a convex sole and is used to form concave parts in furniture.



HANDMADE DUMMIES for the wigmaker of colonial times were also products of the cabinetmaker. There is a wig shop in Williamsburg today, and the wooden heads were produced in The Ayscough Shop.



side to dig up the bottom of the hole. Such a bit did not expel the cuttings.

A modern woodworker going into The Ayscough Shop would not have to ask what the various tools are used for, as that is evident in each case. There are counterparts of all modern hand tools—saws, hammers, chisels, miter box, try squares, compasses, awls, and so on—all of them handmade and odd-looking but designed for the same uses as are the tools of today.

Mahogany is the wood used in the Williamsburg shop, and this is historically correct, for this was the choice of the master workmen and of their customers during the colonial period. Mahogany was carried back to England from the West Indies about 1725, and the cabinetmakers of the day quickly seized upon it as a wood superior to walnut because of its beauty and also because it lent itself nicely to the elaborate carving then in vogue.

According to tradition, Sir Walter Raleigh had one of his ships repaired in Cuba, and the wood used was mahogany. Queen Elizabeth saw this wood in the decking of the ship and expressed admiration for its color and smoothness. Thereupon the gallant Sir Walter had some of the planks torn out and commissioned one of the master craftsmen of the time to make a table of it for the queen. Whether or not the story is accurate, it fits into the picture nicely to explain the rapid adoption of this new cabinet wood in England, and also in the British colony of Virginia.

Designs of Chippendale, Sheraton, and Hepplewhite are prominent among the many fine pieces of furniture to be seen in the restored buildings at Williamsburg, the governor's palace and the residences of the nobility. This furniture has been laboriously gathered from many places, every piece selected with extreme care for its authenticity. Not all of it was made in this country, of course; the affluent gentry of the time imported much from London. But whether it was made here or there, the influence of Chippendale, Hepplewhite, and Sheraton was so great at the time that it was their designs that went into the finest articles on either side of the ocean.

In the restoration of Williamsburg, which has been financed by John D. Rockefeller, Jr., to the tune of millions of dollars, no labor or money has been spared in the effort to make everything authentic and historically correct. The

ELBOW GREASE and skill were two prominent ingredients that produced the beautiful furniture of the early eighteenth century. Every detail was finished with exactness, intricate carving being effected despite the handicap of crude implements. Mr. Kobelbauer, gives an oil finish to a clock cabinet with the same care practiced by his colonial predecessors. The ancient craftsman turned out finished products comparable with the finest that our modern tools and machinery can manufacture.



research department did a prodigious job of investigation and examination of tools so that whatever was put into the cabinetmaker's shop would belong to the period.

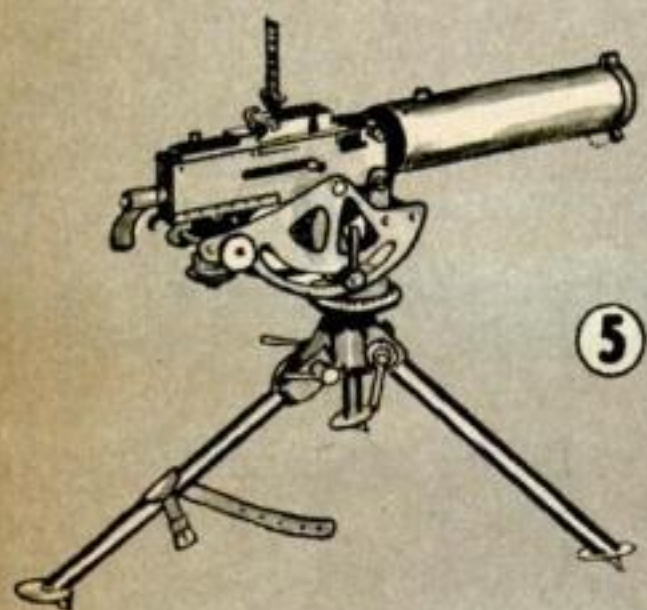
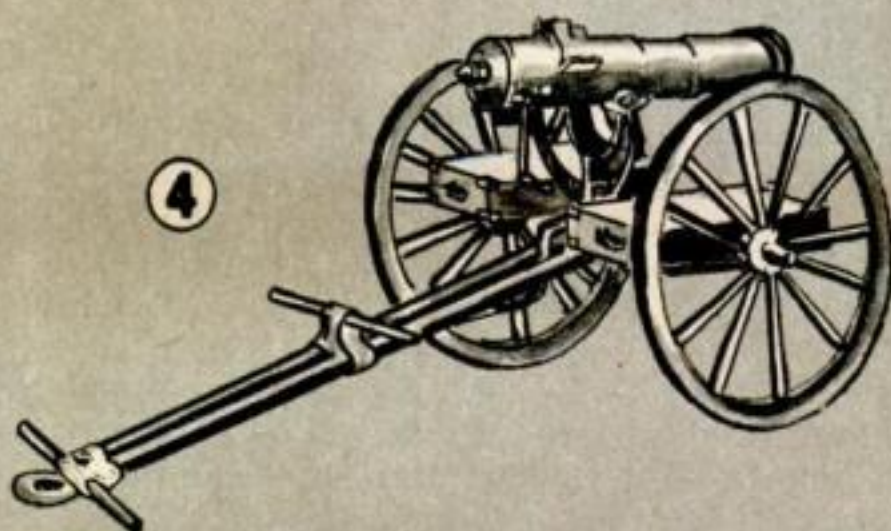
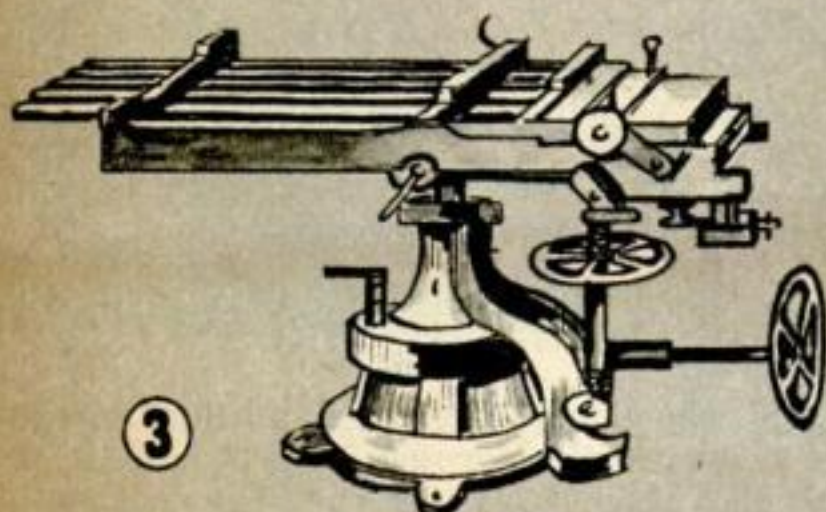
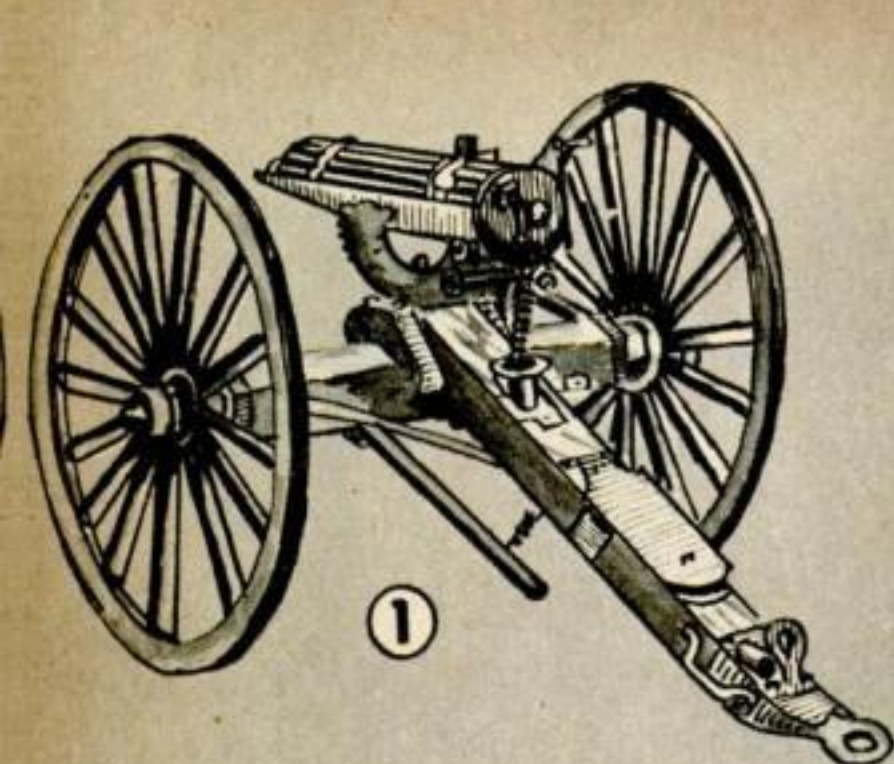
Williamsburg was the colonial capital of Virginia from 1699 to 1779. During those 80 years it was the social, cultural, and governmental center of a vast area, but after the government moved away it de-

clined and was almost forgotten until 1927, when the restoration project was started.

Since the cabinetmaker of that time was such an important craftsman, producing as he did the fine furnishings for the homes of the wealthy and most influential, it was fitting that restored Williamsburg should have a suitably equipped shop of this kind. —GOLD V. SANDERS.

APPRENTICE. A Williamsburg boy, dressed in typical costume of the early Williamsburg days, uses the bulky backsaw in cutting a piece of mahogany. The apprentice did the rough work until he could acquire the skill that could come only after many years of service under the guidance of a master cabinetmaker. In many cases the sons of woodworking craftsmen were brought into the shops to observe and to master the family trade.





- 1 First practical machine gun was Gatling's, invented in 1862. Gun barrels were mounted on a crank-operated central shaft. Hopper above gun fed the cartridges.
- 2 The lighter Gardner gun, with tripod mount, came next.
- 3 Xylophonelike Nordenfeld, popular in Europe 1873-1900, was Spain's ace automatic gun in Spanish-American War.
- 4 Colt Browning, 1890. First automatic to use the gas of exploding shell to extract casing and reload gun.
- 5 Later, Browning added a water jacket for cooling the barrel; became U.S. heavy machine gun in World War I.

Machine Guns...from

By Lt. J. T. HOLMES, AUS

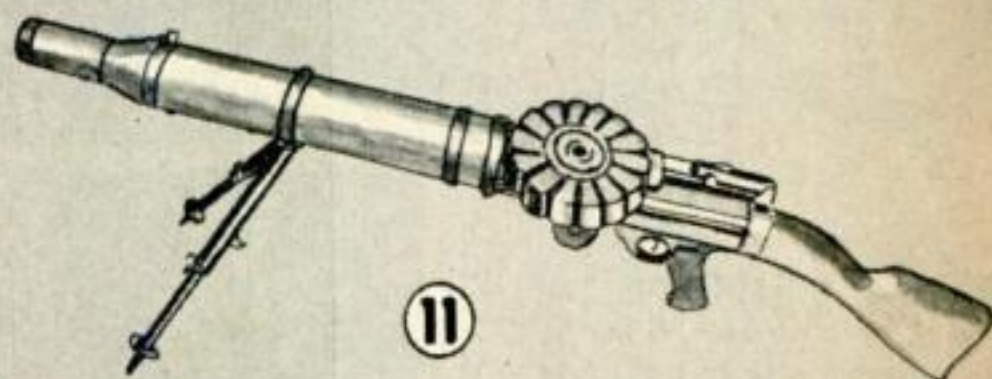
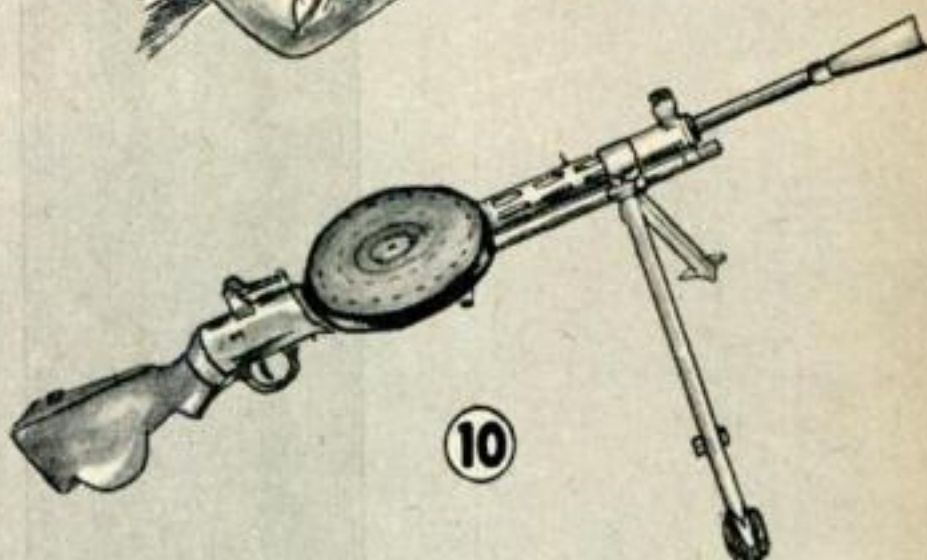
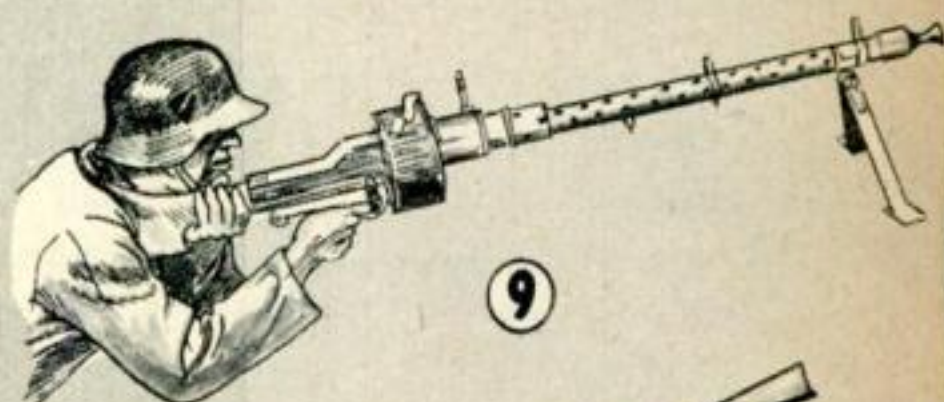
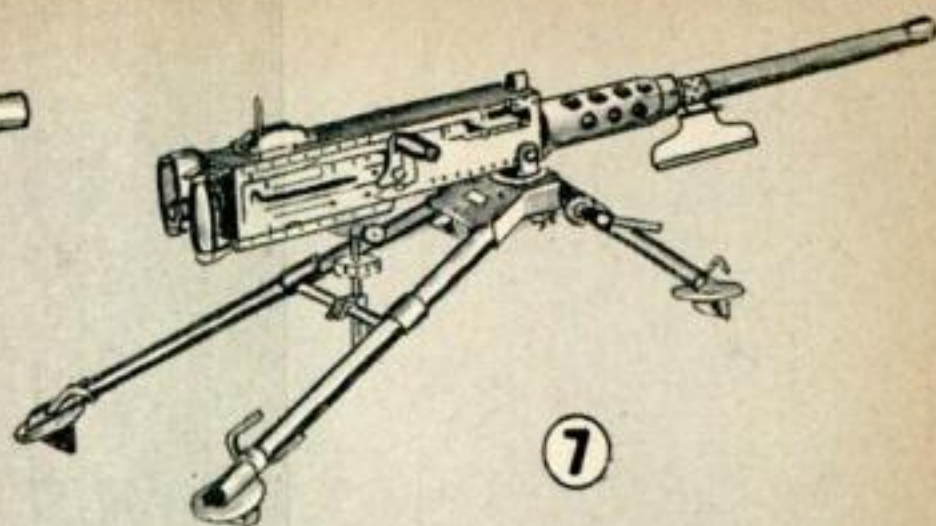
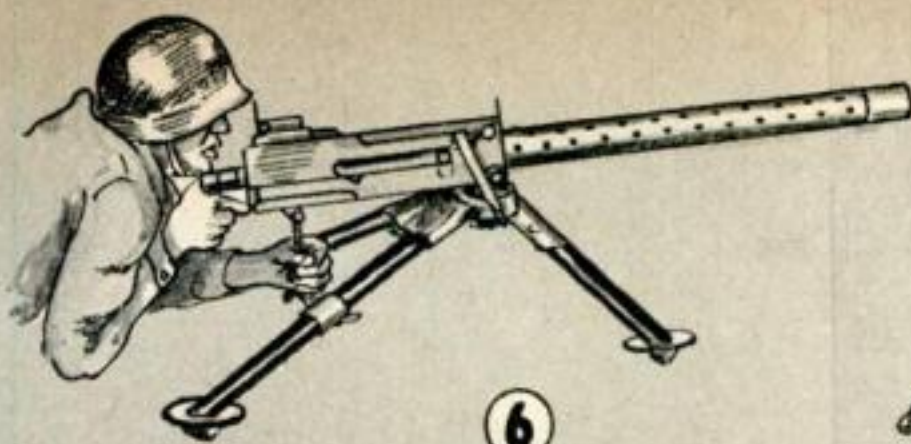
Drawings by JAN HOLMES

STRANGELY enough, the American who invented the first practical machine gun, like the inventor of dynamite, hated war and hoped his invention would bring an end to all wars.

That man was Dr. Richard Jordan Gatling, born September 12, 1818. Unfortunately, the doctor's dream, born of the horrors he witnessed on Civil War battlefields, was not to be realized. He envisioned a

world held from war through terror of his death-dealing, rapid-fire gun. Instead, the machine gun became just another instrument for dealing out mass death. But, as with every development of war, a counter-measure was found—in this instance the tank, which broke the stalemate of trench warfare of 1916-18.

Gatling patented his invention in 1862 and offered it to the Federal Government, but it was viewed with suspicion. Undiscouraged even by a fire which destroyed his experimental work, Gatling hired men to take



- 6 Browning air-cooled gun, lighter than water-cooled model, is standard Army equipment. Fires 60 rounds per minute for 30 minutes.
- 7 Browning .50 caliber is all-around weapon—ground gun, AA piece, and plane armament. Range is about four miles; weight, 82 pounds.
- 8 Nambu, standard Jap 7.7-mm. light machine gun; very effective, especially in jungle.
- 9 German MG 34 is recoil-operated, belt-fed, air-cooled. Used as a ground and AA weapon.
- 10 This 1937-model Russian Degtyarov weighs only 18 pounds. That's a 47-round drum magazine mounted in front of the rear sight.
- 11 The Lewis (American) gun was adopted by Great Britain in 1909, and late models are still in use. Air channels cool the barrel.

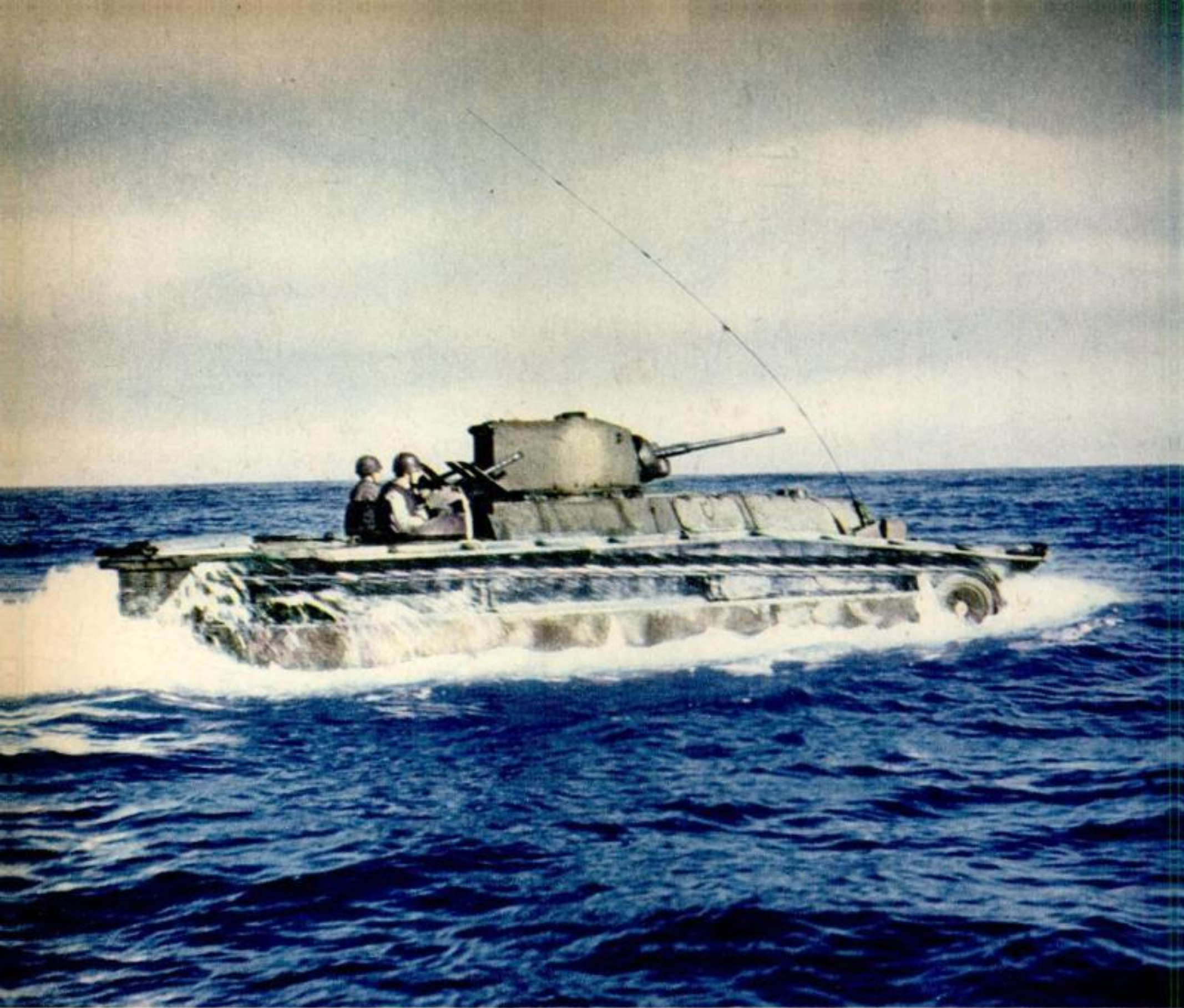
Gatling to Browning

the weapons out on Civil War battlefields and demonstrate their use to skeptical military men. In the closing years of the war General Butler used the gun against Confederate infantry in an engagement along the James River in Virginia. An improved model of Gatling's original design was adopted as the standard machine gun of the United States Army in the early 1870's.

While Gatling was working on his weapon, the mitrailleuse, another form of machine gun, was being developed in Brussels, Belgium. This clumsy weapon was

used by the French in the Franco-Prussian War of 1870 with very poor results. The Prussians, who had a few machine guns of their own, were greatly impressed by the possibilities of automatic weapons but discarded the mitrailleuse for the Palmcrantz-Nordenfeld and several other models.

Chronologically, the Gardner, invented by an American, followed the Gatling gun. Gardner was years ahead of his time in the design of the tripod stand and the lightness of his weapon, which was widely copied by European arms [\(Continued on page 208\)](#)



GOING ASHORE, an LVT(A)1 amphibian churns the blue waters with its whirling treads as it heads for the beach. Its 37-mm. cannon is ready to fire at enemy pill-boxes, and the two machine guns are manned. Its low silhouette makes a poor target.

ON THE BEACH, the skipper and his assistant come up for a look around. The two machine gunners are on the watch for enemy planes. Radio maintains constant contact with forces ahead and behind. (Note aerial in upper photograph.) Tracked landing vehicles of this type first saw action at Kwajalein on February 1, 1944. A later model is armed with the 75-mm. cannon.



MEET THE LVT'S

Beach Busters

Because they can run in water, sand, or jungle, they are leading the way in the march on Tokyo.

By ALDEN P. ARMAGNAC

"THERE is not the slightest shadow of doubt that the overwhelming victories of our forces at Tarawa, Kwajalein, Saipan, Tinian, Guam, Palau, and Iwo Jima would not have been possible without the Amtracs."—Vice Adm. E. L. Cochrane, U. S. Navy Bureau of Ships.

AT OKINAWA, the newest members of America's growing family of Amtracs waddled ashore, toted cargoes up the hills

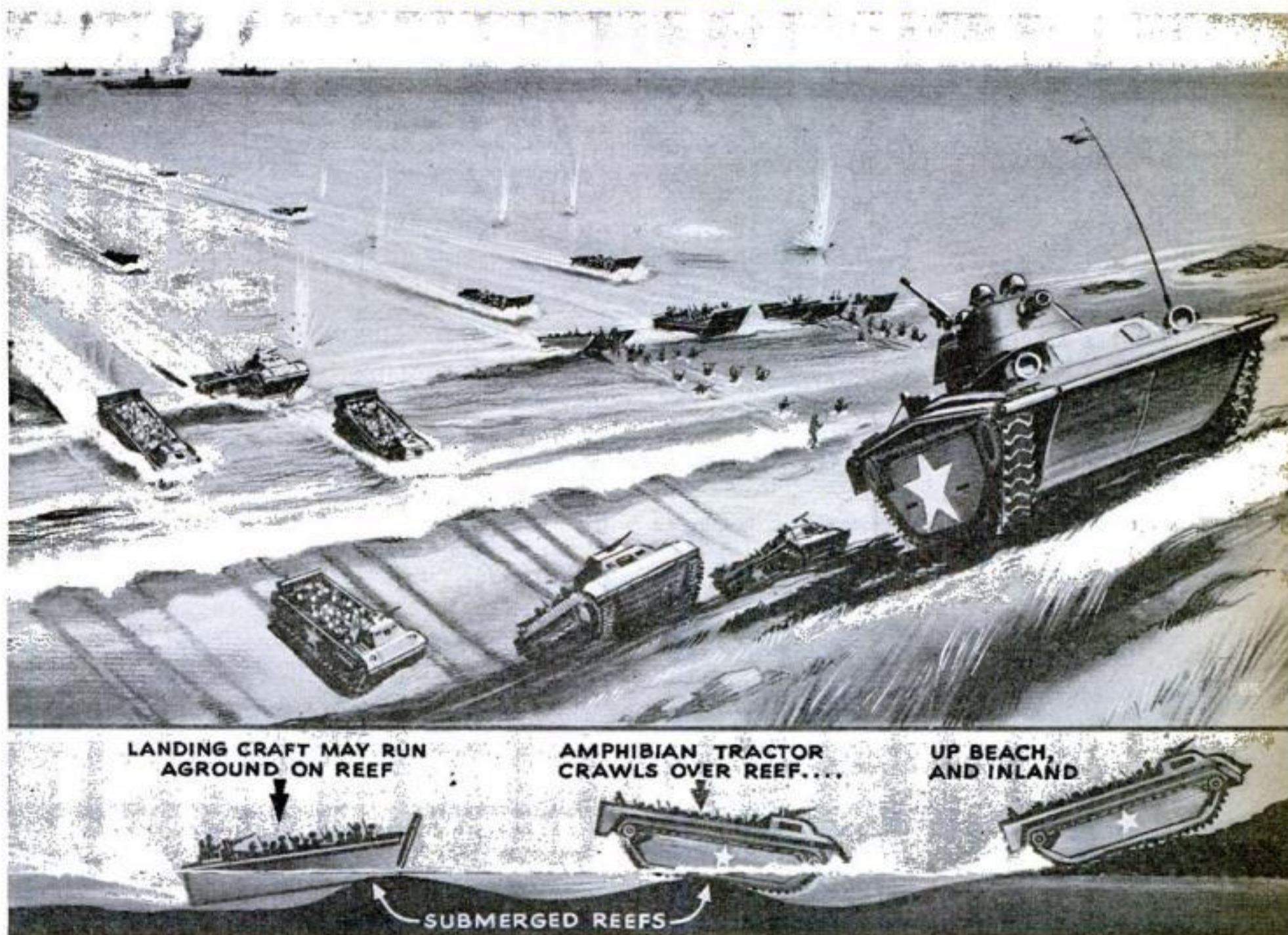
to the front line, and hauled back the wounded men. So censorship now has been lifted sufficiently to permit you to know about our newest amphibian tractors.

Like the Alligator and the Water Buffalo, these new Amtracs are officially LVT's (Landing Vehicles, Tracked). They have neither wheels nor propellers, but travel over land or water by using their endless tracks as ground grippers on terra firma and as paddles in the sea.

They are descendants of a "rescue tank" invented a dozen years ago by Donald

AMTRACS CRAWL OVER REEFS THAT STOP REGULAR LANDING CRAFT

At Okinawa, the Japs counted on false beaches and underwater reefs to halt invaders offshore. They had not figured on our amphibian tractors, which can climb over such obstacles. What is more, these cargo, troop, and gun carriers don't stop at the beach, but crawl ashore and go after the enemy over the roughest terrain.



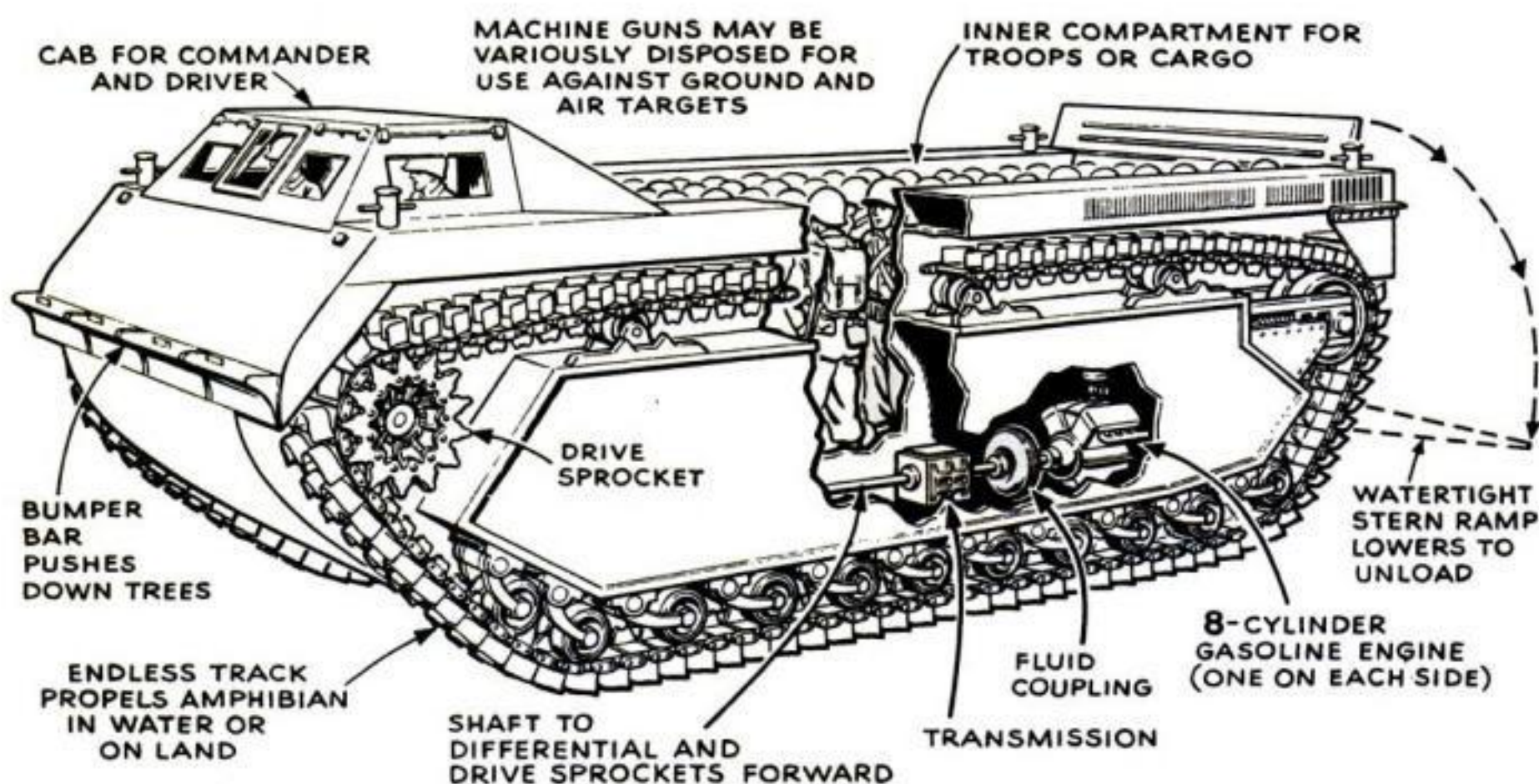
Roebing, grandson of the famous bridge builder, to save persons marooned in the Florida Everglades by tropical hurricanes. Navy and Marine Corps experts saw news pictures of Roebing's machine (P.S.M., Jan. '36, p. 42), and ordered a couple of aluminum pilot models. Few persons suspected then that Roebing's invention would help to shorten bombers' flights to Tokyo in 1945, but that's exactly what his machine's descendants have done. They've now swum and rolled to within 350 miles of Japan.

If you want to be technically correct, don't speak of an LVT as an "amphibian tank"—especially if you are talking with a certain Marine Corps officer who had three shot out from under him in a single engagement. The ones that carry troops or cargo

are "amphibian tractors," or Amtracs for short, and their thin plating stops nothing heavier than small-arms or light machine-gun fire. Therefore, their attack often is led by one or two waves of armored amphibians, a later class with more protection.

Typical armament for an amphibian tractor consists of four machine guns—either two .50's and two .30's, or all .50's. The choice depends upon a nicety of tactics. Where aerial opposition is expected, the .50 caliber weapon serves as an antiaircraft gun and is used throughout. But when Allied airpower neutralizes the enemy's, .30 caliber bullets kill Japs on the ground just as effectively, and more ammunition can be stowed aboard. Armored amphibians mount both machine guns and comparatively heavy weapons—a 37-mm. gun or a 75-mm.

HERE ARE SIX MEMBERS OF THE GROWING AMTRAC FAMILY



CUTAWAY VIEW of the LVT(3) Bushmaster shows fluid drive that makes this model easier to handle.

LVT (1), the famous Alligator, was developed from a hurricane-rescue vehicle. Many of these pioneer amphibian tractors are still in use.

LVT (2). Amtracs gained new size and power in the Water Buffalo, which first saw action at Bougainville in 1943. It is 26 feet long, weighs 14 tons.



howitzer—and start firing from the water as soon as the preliminary barrage from major warships has lifted.

Fuel tanks filled with high-test gasoline, invasion-bound LVT's take to the water from the lowered bow of an LST—the Navy's versatile ocean-going vessel named for its original use as a Landing Ship, Tank. By way of comparison, it takes 3¼ minutes to unload 17 LVT's from an LST; 25 to 90 minutes to unload a single LVT from a larger ship.

Taking radio orders from their group commanders, the amphibians first jockey into place on the "line of departure"—a standard assault formation, resembling that of race horses at the barrier. A second command, and they're off. Don't expect them to show spectacular speed, for they're work

horses rather than sprinters, with a pace of four or five knots in the water.

As an Amtrac nears a hostile shore, the spang of bullets against its side warns occupants not to risk a peek at what is going on, but to crouch in safety. Usually an observer in a protected position volunteers a running account of the situation.

Given sufficient notice where to land, the driver stars in the climax of the show. It is up to him to beach the machine through heavy surf, if necessary, and thorough training has taught him just how to do it. Above all, he must never let a wave catch him abeam. True, LVT's have power pumps that discharge water normally shipped aboard—but, for all their virtues, Amtracs are not submarines.

A grating noise announces that the LVT

... EACH DESIGNED TO DO A SPECIFIC INVASION JOB



LVT (A) (1) was our first armored amphibian. Built exclusively for fighting, this 18-ton vehicle looks like a seagoing tank with its turret mounting a 37-mm. gun. Its crew of six men is protected by relatively heavy armor.

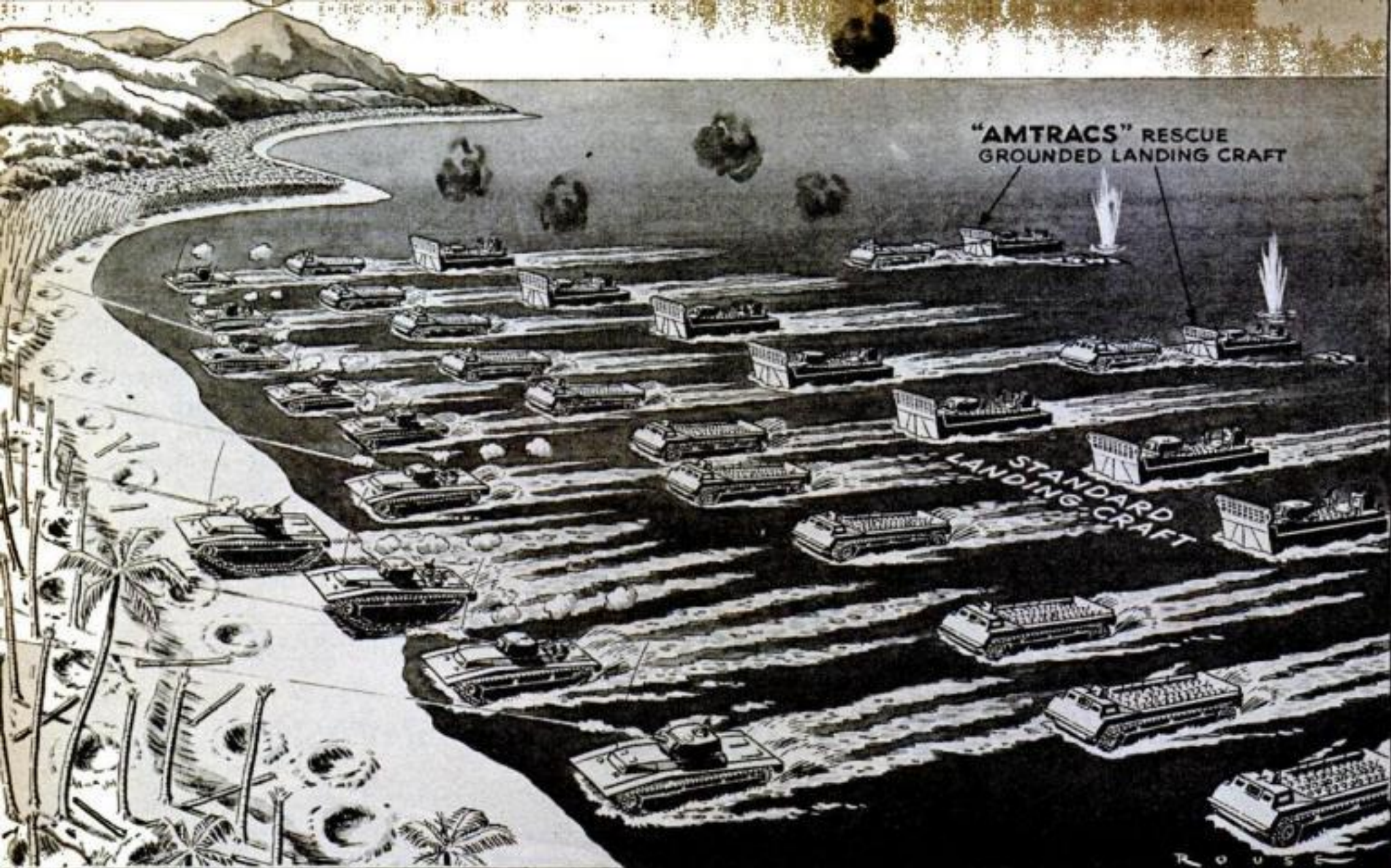
LVT (3), the Bushmaster, was kept under wraps until Okinawa. Its outstanding new feature is the fluid drive that takes it up hills with little shifting of gears.



LVT (A) (4), the latest armored model, has a 75-mm. howitzer that can lob shells over coastal ridges. A 20-tonner, it is handled by five men. Its debut was a surprise to the Japs at Saipan.

LVT (4) introduced the rear ramp, a great help in unloading under fire. Twenty-six feet long, it carries 45 men, a jeep, or a fieldpiece with crew.





INVASION TACTICS usually call for one or two waves of armored amphibians to lead the way, followed by Amtracs loaded with men and supplies. When regular landing craft get stuck on reefs, the amphibians tow them off. Men in the open-top Amtracs crouch low for protection behind the steel walls, with observers in shielded positions telling them what goes on. Pennants on radio antennas identify group commanders' vehicles. All the other Amtracs fly pennants, too, and only our men know which kind marks the leader. If the Japs get wise to the code, it can be changed quickly while the fight goes on.

has reached shore, and, dripping brine, it goes into action in its terrestrial element. Incidentally, the design of its double-purpose track cleats deserves more than a passing glance; shaped like the blades of a Pelton water wheel, they have applied a classic hydraulic principle in reverse, for aquatic propulsion. Like the tracks of a land tank, they are used for steering, both afloat and ashore. To turn, the driver runs one track faster than the other; to face about, he operates them in reverse directions.

On land, the 20-mile-an-hour speed of an LVT cannot compete with that of a tank. Where it scores again is in its incomparable ability to overcome every variety of difficult terrain. Marines struck a curious type on the beach of Iwo

Jima—volcanic sand, so soft and yielding that they might as well have been struggling through a quagmire. But their amphibian tractors rode over it with ease. Likewise, as at Bougainville, tropical rains that turn roadways into beds of thick mud cannot stop them. During the Cape Gloucester invasion of New Britain, our troops received supplies in LVT's over no roads at all. Marines consider them tops among jungle machines. They have enough power to crash through the toughest thickets, and to run up hills too (*Continued on page 206*)

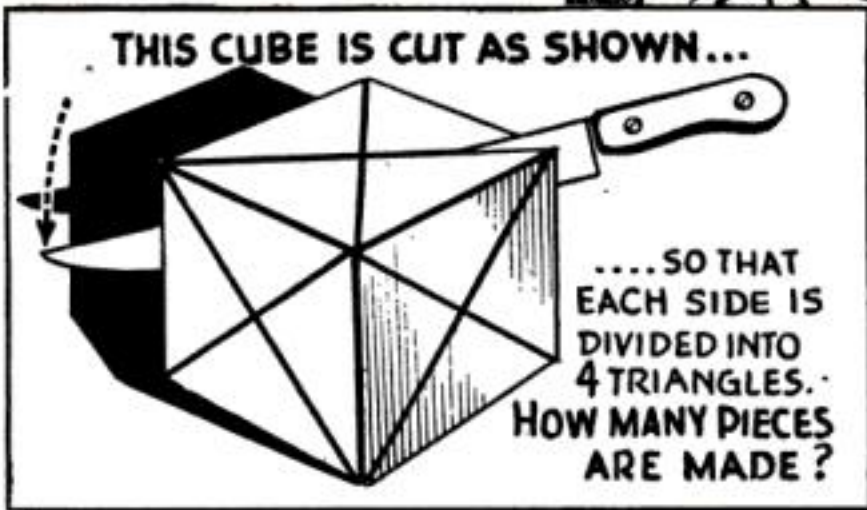
NO SUPERHIGHWAYS are needed by these first-rate jungle machines. Mud, trees, or volcanic sand can't stop them. The "duck" truck, a wheeled amphibian, could never get over terrain like this, but Amtracs take men and supplies inland and bring out the wounded.



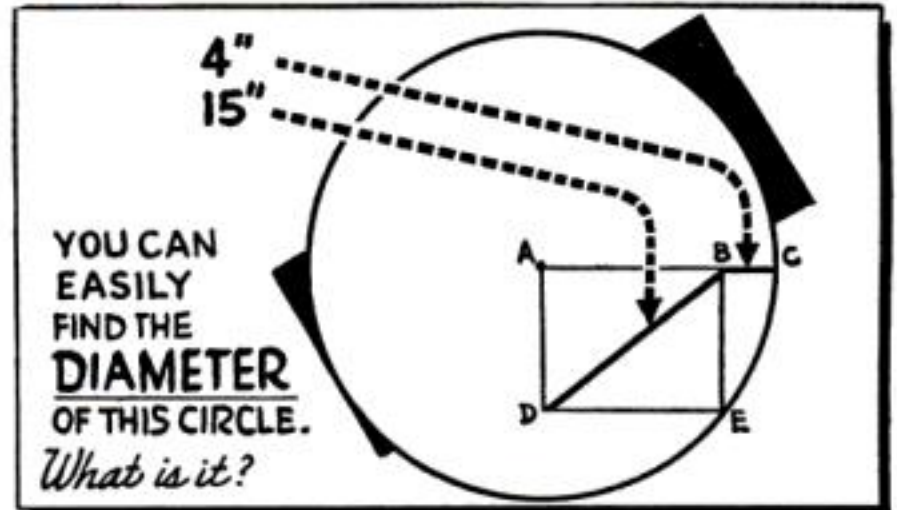


Your I.Q.?

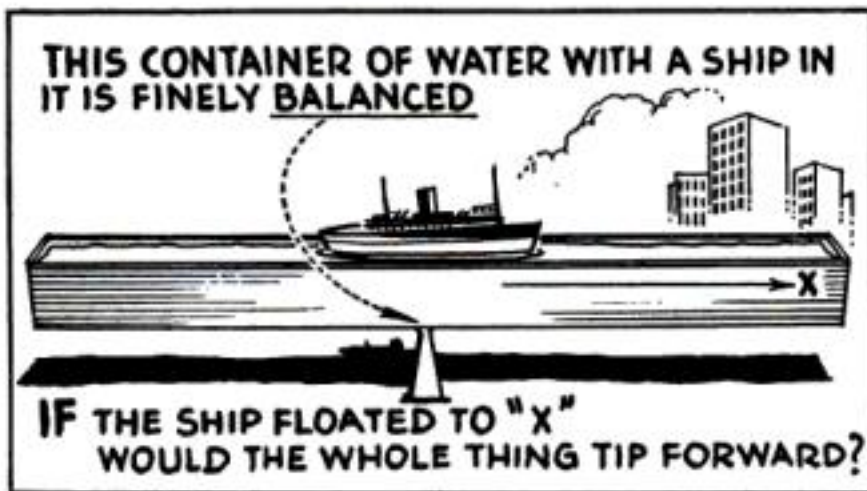
DON'T LOOK NOW, but after you have tried to solve these problems, turn the page upside down and read the correct answer under each picture.



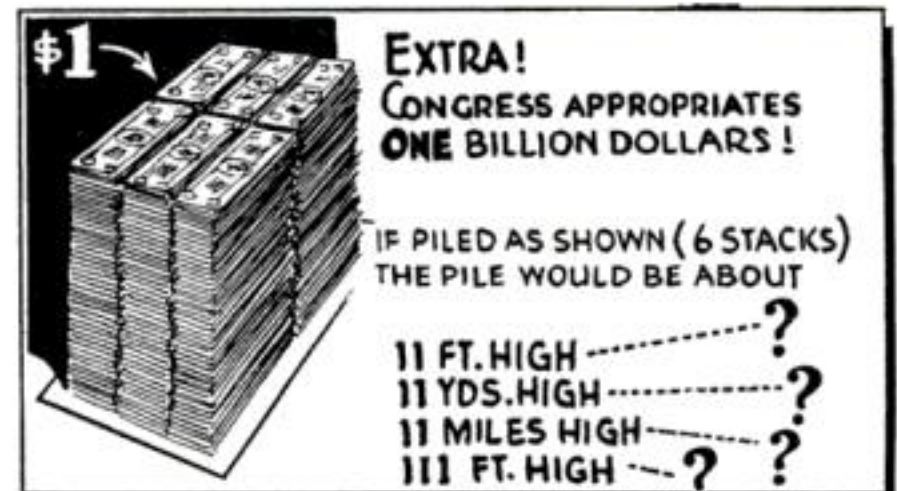
Since all cuts meet in the center of the cube, there are four pieces for each of the six sides—24 pieces.



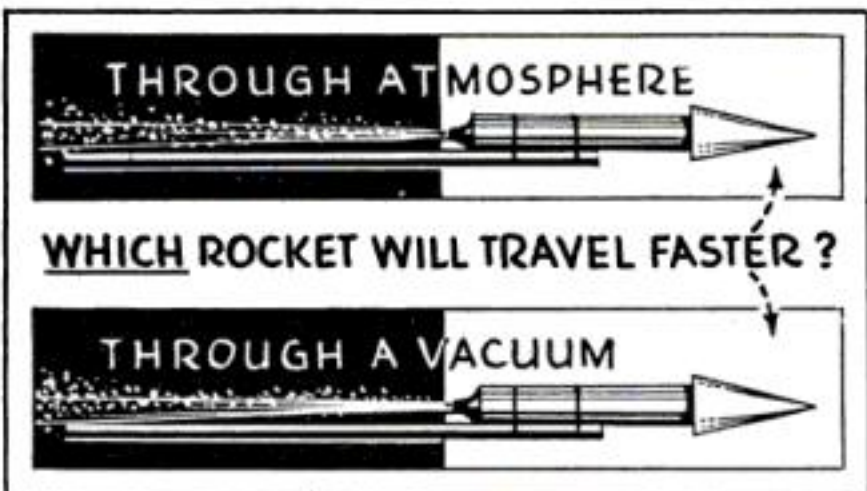
The distance AE, which is a radius of the circle, is equal to BD, or 15 inches. So, diameter is 30 inches.



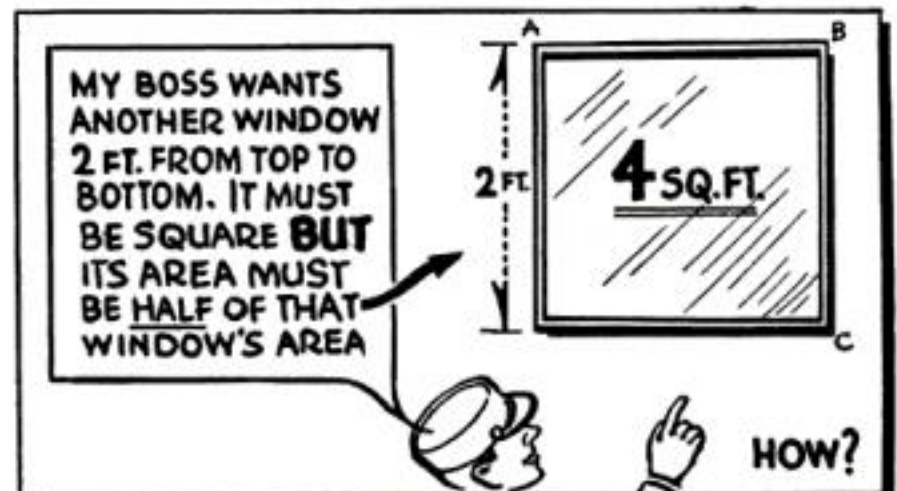
Ship's position would not affect balance, because its weight is displaced and distributed throughout tank.



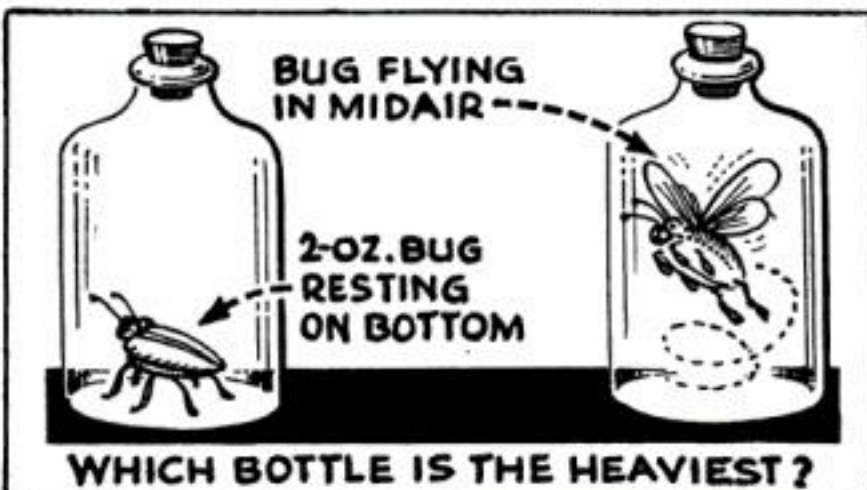
New dollar bills stack 233 to the inch. In one pile, a billion would reach 66 miles; in six piles, 11 miles.



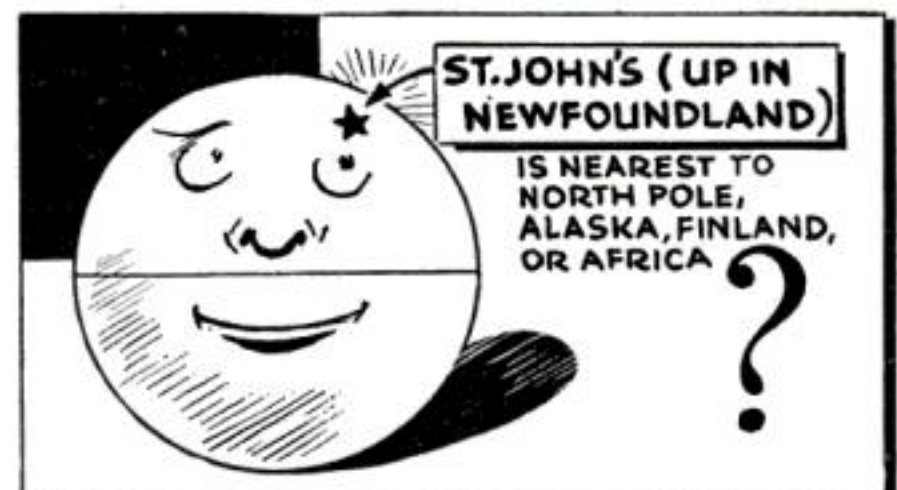
Rocket in vacuum travels faster. Air doesn't help let propulsion; its only effect is to offer resistance.



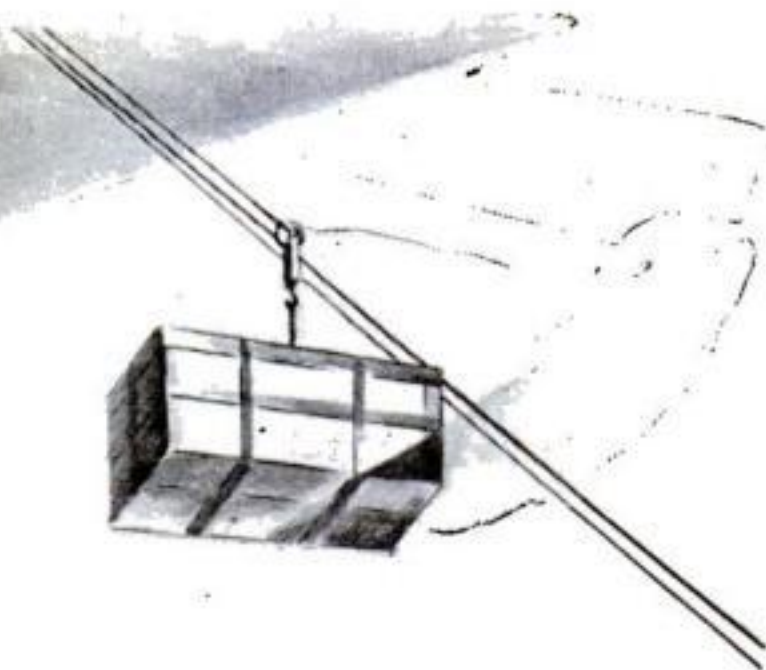
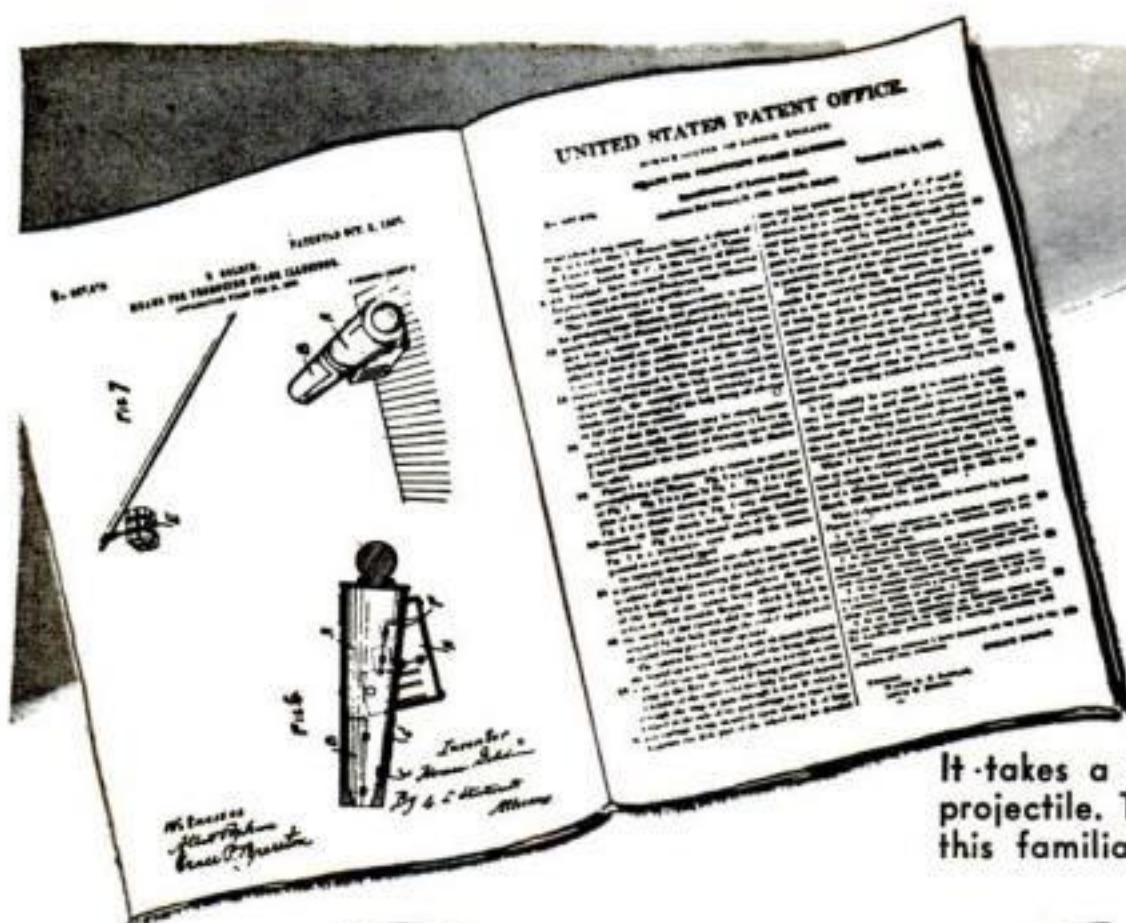
Sure, it can be done. Smaller window has a diagonal of two feet and is set with corners at top and bottom.



With equal amounts of air, the bottles weigh the same. The flying bug's weight is still in the bottle.



Africa, in the region of Morocco, is closest by a long way. Check on this with a globe and dividers.



It takes a special kind of gun to use a girl as a projectile. That's why you can get the low-down on this familiar trick from Washington for 10 cents.

Patents Give Away Magicians' Secrets

MYSTERY IS STRIPPED FROM STAGE ILLUSIONS BY PAPERS PROTECTING IMPROVED APPARATUS. YOU CAN DUPLICATE SOME OF THESE STUNTS.

By MICHEL NOSTRADAMUS

(Pen name of one of America's leading amateur magicians.)

UNLESS people ask the question, "How does he do it?" there isn't much point in an exhibition of magic. They go to the show to be mystified, and come away slightly irritated because they *are* mystified.

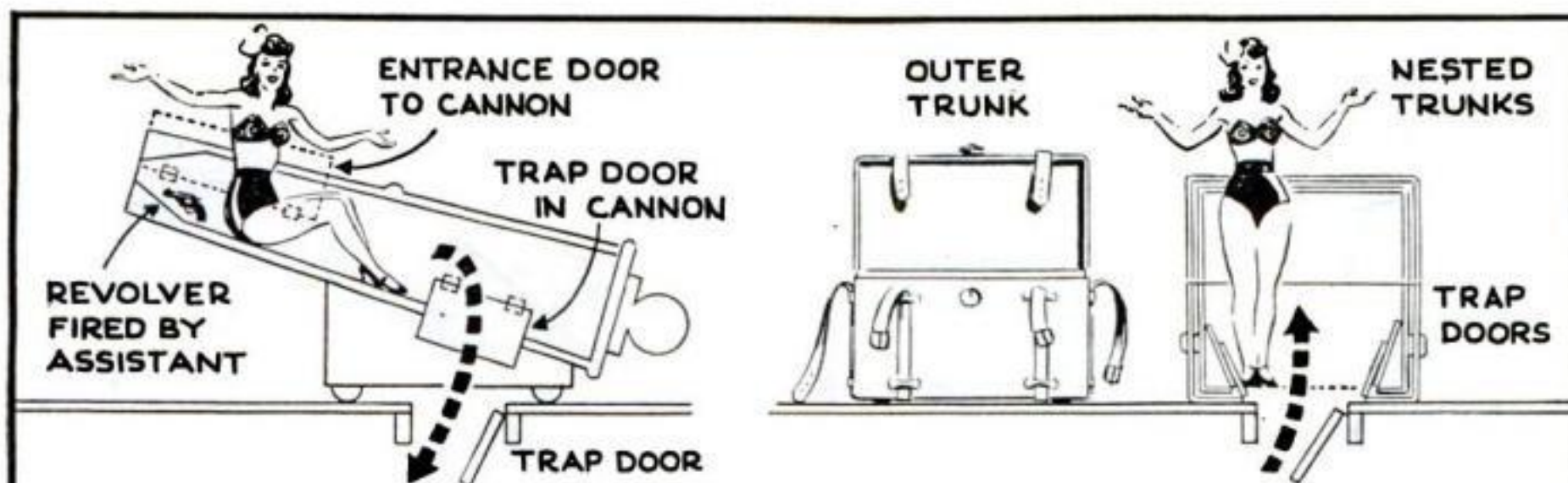
It's easy to find out how any trick is done if the apparatus has been patented in the United States. For a dime you can get any one of the papers issued by the U. S. Patent Office and figure out how the magician saws a lady into two pieces, causes a skeleton to appear in an empty cabinet, or loads a girl into a cannon and shoots her into a nest of three locked trunks hanging by a cable up near the roof.

Uncle Sam tells all; and since many of the big-time illusions are based on apparatus patented 17 or more years ago, you are at liberty to go ahead and reproduce these if you have the skill to build the equipment and learn the routines. The Patent Office, custodian of these secrets, lists "Illusions" under Classification 272, subclassification 8; and there are other subheads covering

various smaller appliances of similar kinds.

The chances are that the tricks are not new—and weren't when the patents were issued. In each case it was an improvement on the apparatus that was patented. The first important stage illusion on which a patent was granted was devised in England in 1863 by a Professor Pepper, of London's Polytechnic Institute, and was known as "Pepper's Ghost." It required a huge sheet of glass inclined forward on the stage at such an angle that it would reflect an illuminated pit or lower stage. Actors appeared behind the glass, which was invisible to spectators, and other actors representing ghosts or skeletons took their places on the hidden stage in front of and below the glass. Turning on the pit lights produced the intended result, which was, in the quaint phraseology of patent papers, "to associate on the same stage a phantom or phantoms with a living actor or actors so that the two may act in concert."

The Professor patented his "Metempsychosis" in the United States (No. 221,605) in 1879. In this illusion, miraculous transformations took place with the aid of a mirror set at an angle. One of its many



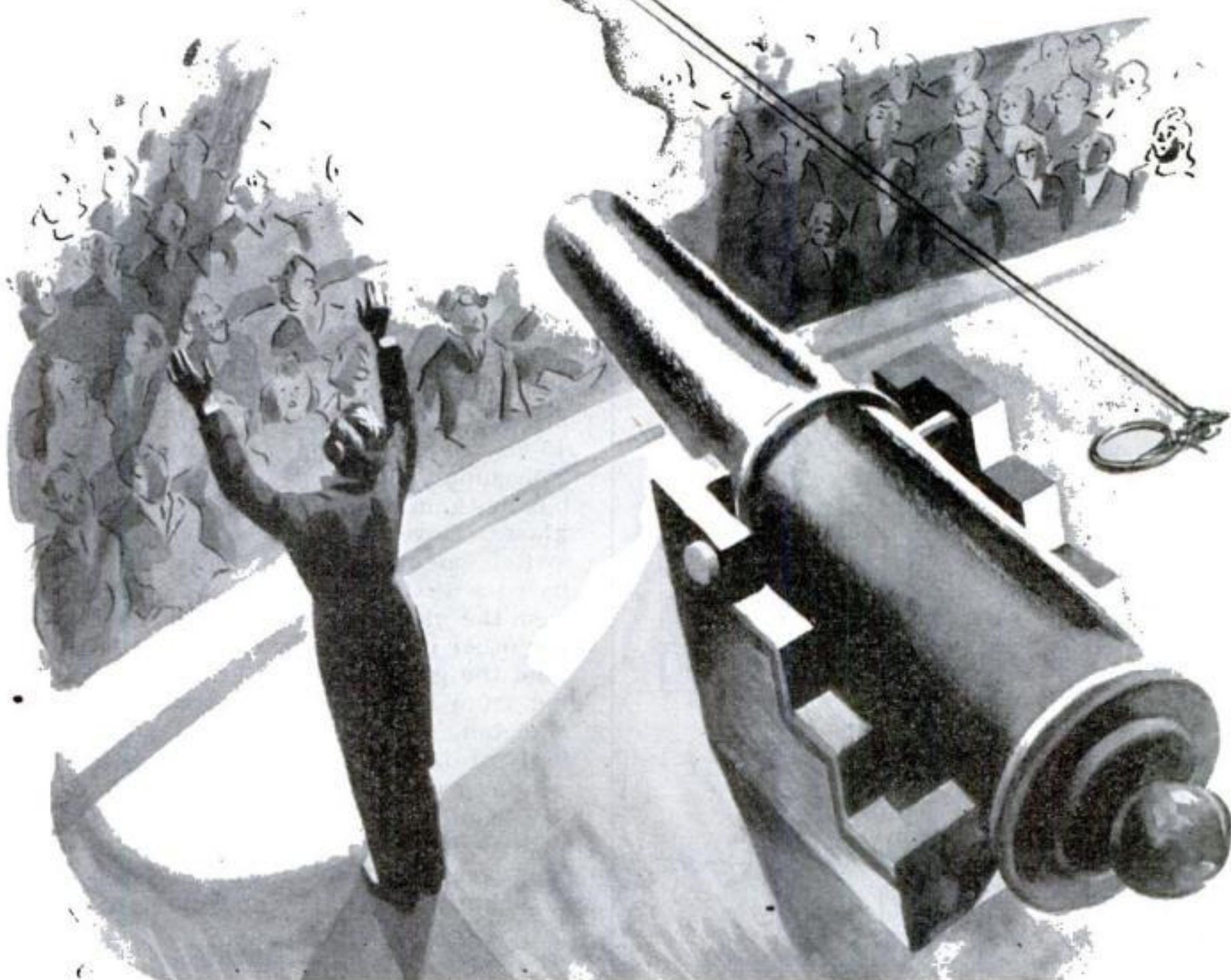
The girl slips into the cannon through an opening near the muzzle, and out again by way of a trap door concealed by the gun carriage. Before disappearing below stage, she fires the pistol shown.

When the trunk nest is lowered to the stage, the solid outer trunk is opened, and the other two are set over a trap door, under which the girl is waiting, ready to climb up and be released smiling.

THE TRICK—AND HOW IT'S DONE ↗

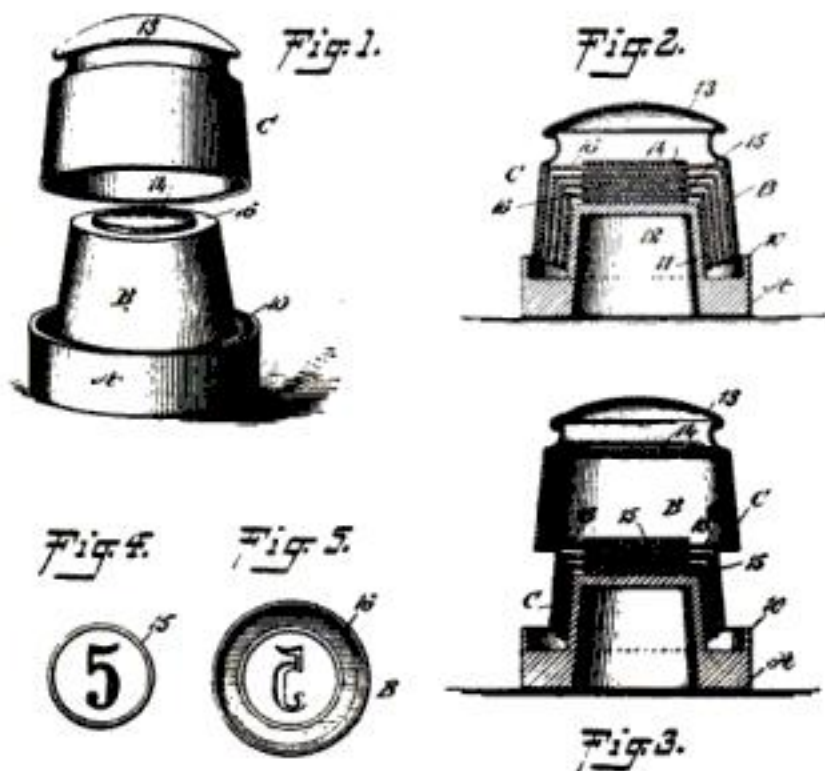
SHOOTING A GIRL OUT OF A CANNON.

Target is a nest of three trunks, all locked and strapped, hung high on a cable that reaches to the roof of the theater. The big cannon is loaded with its human ammunition. The command to fire is given. BOOM! Assistants lower the trunk to the stage, and feverishly unlock, unstrap, and open the outside trunk. They lift out the next trunk and repeat the process. Out of the third trunk steps the girl.



J. R. ARMSTRONG.
TRICK TOY.

APPLICATION FILED AUG. 9, 1902.



MINT YOUR OWN. Just put a blank metal disk in this stamper and hit the cover a blow. Then lift the lid and you'll find a real U. S. coin; that is, if you have previously loaded nested section with a dime or a cent or whatever is to be "made."

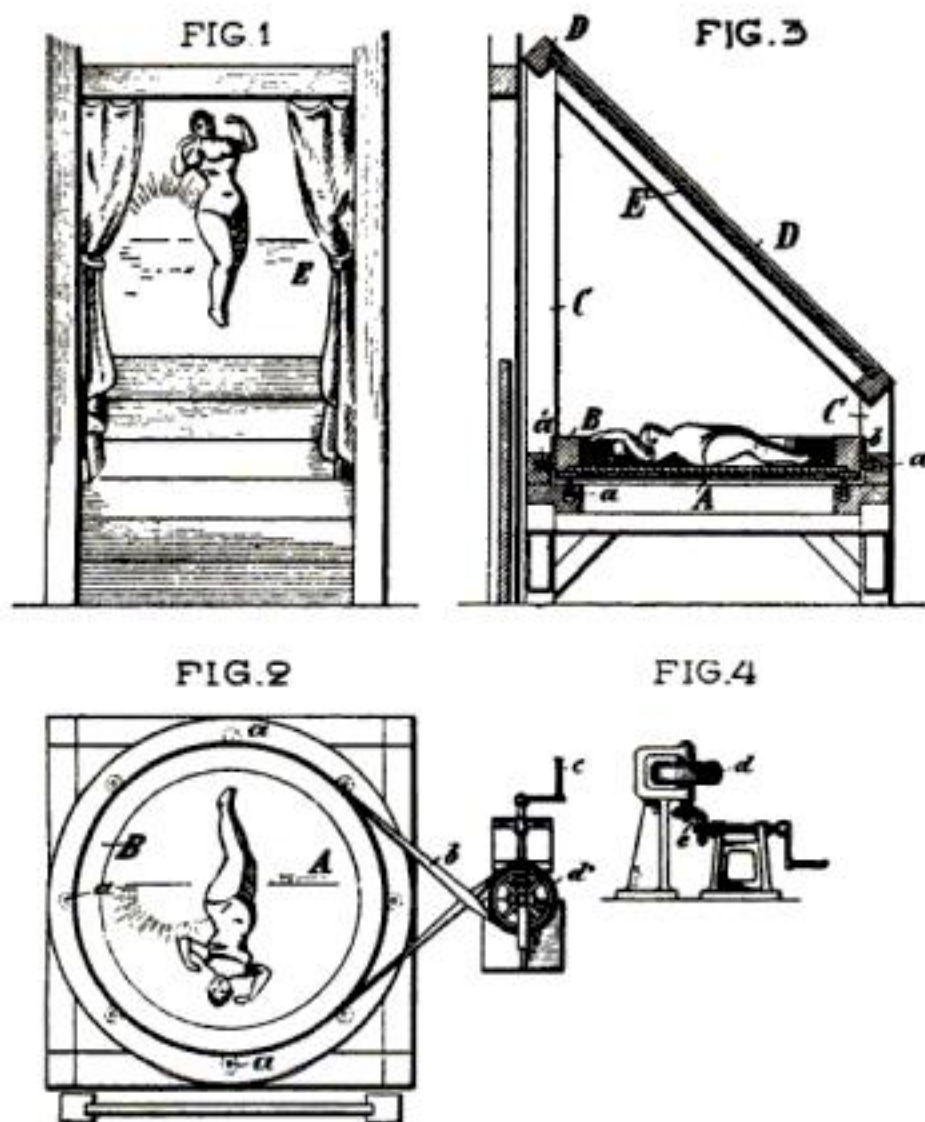
"AMPHITRITE THE SEA NYMPH" rises from the water and seems to twist and turn in midair. The patent drawings, made over half a century ago, reveal that she is lying on a revolving turntable and reflected in a slanting mirror seen by the spectators. Apparatus for the illusion was adapted from an earlier one by a London professor.

G. CASTAN.

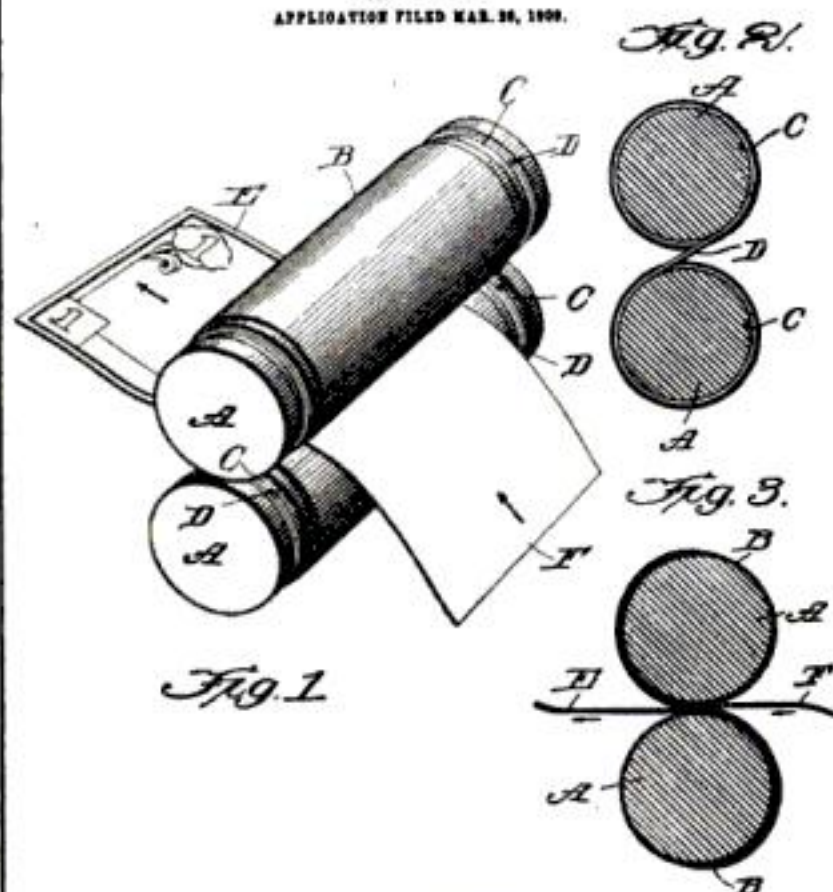
THEATRICAL APPARATUS FOR APPARENTLY SUSPENDING A PERSON
IN MID AIR.

No. 389,198.

Patented Sept. 11, 1888.

F. L. OLESON.
ILLUSION TOY.

APPLICATION FILED MAR. 20, 1909.



MACHINE TURNS OUT DOLLARS. The dollars are real, too—placed so that they will issue as blank sheets of paper are fed between rollers and go out of sight inside of the trick device. You roll out "dough" while cylinder's supply lasts.

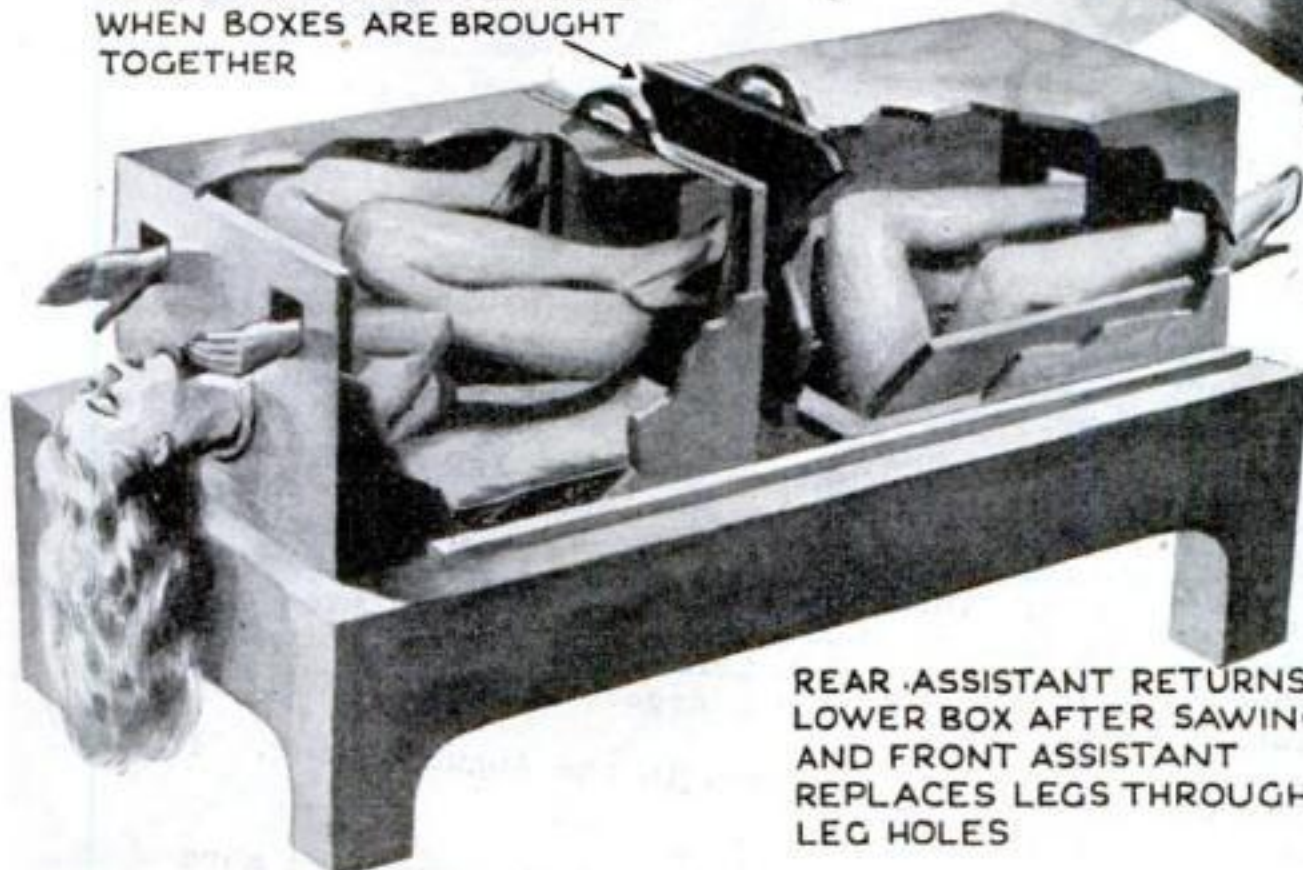
adaptations was "Amphitrite the Sea Nymph," the patent drawings for which are shown on this page. Drawn-back curtains disclose a marine scene, in which a beautiful young goddess of the sea rises out of the water, performs graceful motions in the air, and finally sinks beneath the waves.

Of the various devices loosely classified under the head of "Pepper's Ghost," the best for miniature construction is the transformation of a dummy into a skeleton, both of which can be doll-size. For this, get a square box with an open front and provide a sheet of glass to run at a 45-degree angle from front to back. You supply lights at the top of the box both in front and back of the glass. Governed by a two-point switch, one set of lights can be alternated with the other so that in one case the glass is transparent, and in the other it becomes a reflector. Behind the glass is the doll, while facing from the side of the box is the skeleton. Switching the lights seemingly transforms one into the other at the will of the operator.

Use of a double-pointed rheostat will produce a dissolving change. In any case, the skeleton must be hidden from normal view and the light-

SAWING A WOMAN IN HALF need not be messy if you provide two women and a container arranged like this one. The girl whose feet show lies in the box space below, while the other one jackknifes in the forward compartment. The magician saws, the halves are drawn apart, and panels are inserted to dispel doubt. Later, a girl emerges whole.

THESE PANELS ARE REMOVED WHEN BOXES ARE BROUGHT TOGETHER



REAR ASSISTANT RETURNS TO LOWER BOX AFTER SAWING, AND FRONT ASSISTANT REPLACES LEGS THROUGH LEG HOLES



ing made indirect. This is done by closing the front of the box except for an upright aperture like a door that comes a trifle higher than the doll's head. As exhibited life-size in side shows, the two figures are often incased in upright open coffins.

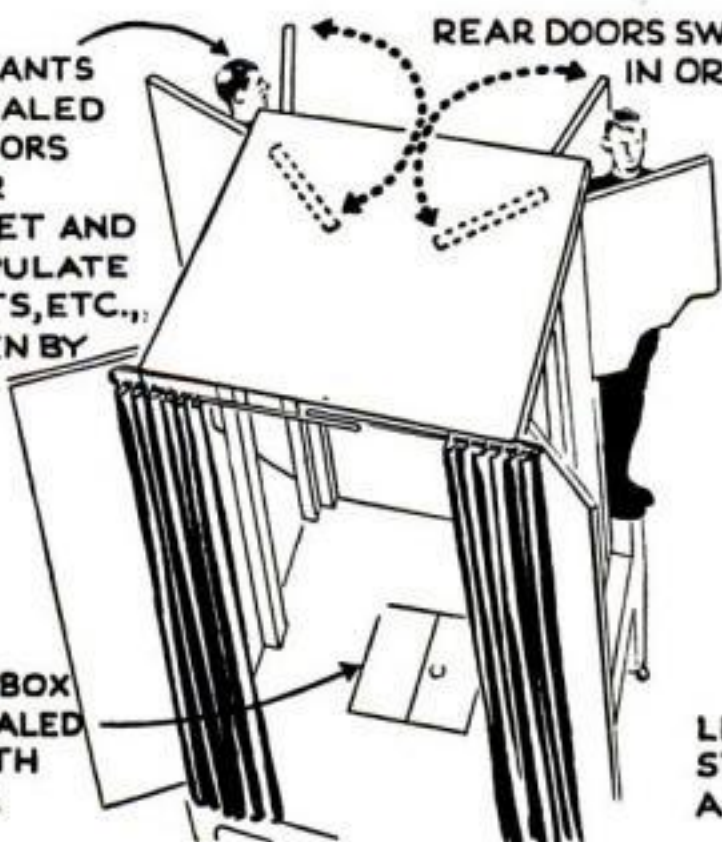
Aided by the revelations of the Patent Office, you can reproduce such whimsical

little gadgets as the breakaway fan, which spreads normally when opened in one direction and practically disintegrates if pulled the other way. You can construct a machine that will turn out coin of the realm when you feed it blank metal disks, or one that will produce a crisp, spendable bill when you roll in a sheet of white paper.

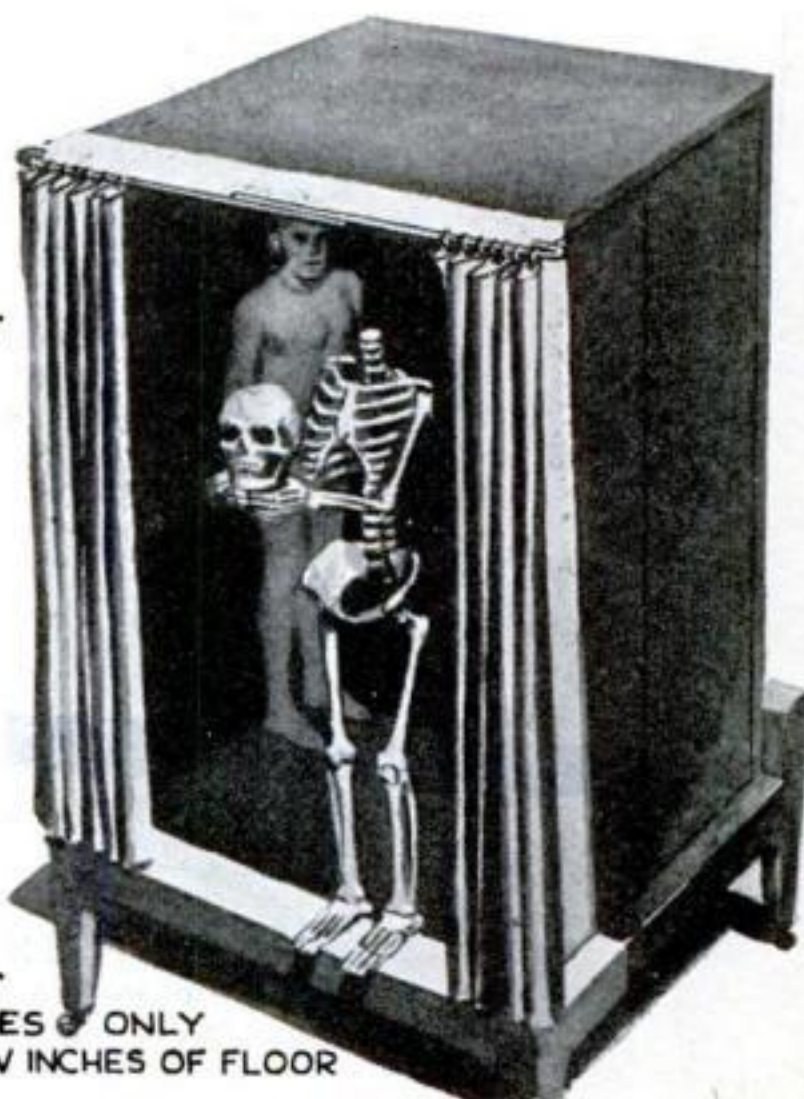
MAGIC CABINET is shown to be empty. Curtains are drawn, doors are closed, and then things begin to happen. When it's opened, a skeleton has appeared. He was behind one of those doors, and picked up properties from floor box. Lighting helps.

ASSISTANTS CONCEALED BY DOORS ENTER CABINET AND MANIPULATE GHOSTS, ETC., UNSEEN BY AUDIENCE

LID OF BOX CONCEALED BENEATH FLOOR



LIGHT STRIKES ONLY A FEW INCHES OF FLOOR



**POPULAR
SCIENCE**
M O N T H L Y

353 FOURTH AVENUE • NEW YORK 10, N.Y.

The Editors

*Suggest a letter to
C A A from editors
based on experiences
in Air Vacation
— D. E. F.*

The Administrator of Civil Aeronautics,
Washington 25, D. C.

Dear Sir:

In the interest of more and safer flying in privately owned aircraft after the war, POPULAR SCIENCE MONTHLY has just completed a project unique in aviation journalism.

To discover what was right — and what was wrong — with the nation's approach to the problems of private flying, we dispatched two men on a trip of almost 3,500 miles in a light airplane. These men are experienced pilots of small planes, yet they encountered enough difficulties to give pause to those who talk in terms of a half million or a million private planes within a decade after the war ends.

The story of their trip began in the August issue. It is concluded in this issue.

In the years of peace to come, better planes and more landing fields will be needed if the airplane is to take its place in our transportation system as a vehicle of personal utility. But more than that is indicated. We should like to make the following recommendations:

Better navigational aids on the ground, easily visible from the air, are imperative.

No field catering to the private pilot should be marked on aeronautical maps unless it is properly maintained and readily identifiable from the air.

A means should be found for posting the periodic weather sequences at all personal-flying fields. The safety of all air traffic may ultimately necessitate grounding planes flying by contact when their pilots propose to venture into bad-weather areas.

These are our findings, submitted in a spirit of co-operation to the end that personal flying may attain the stature it deserves.

Most sincerely, .

The Editors

THE FLIGHT ROUTE, like many other things about the trip, was finally decided by the weather. Francis and Groenhoff had planned to return from Denver to New York by way of Nebraska and Iowa, but they found that the best-laid plans of air tourists are subject to change by the whims of winds and clouds.



POPULAR SCIENCE Takes You on *A Flying Vacation*

3,430-MILE JAUNT COST UNDER FOUR CENTS A MILE

By DEVON FRANCIS

Photographs by HANS GROENHOFF

AT THE Goodland, Kan., airport, as we voyaged westward on our lightplane vacation, the meteorologist had warned us of impending thunderstorms. And now, bent on reaching Denver before nightfall, we had become lost over the Colorado plains country.

That had been the melancholy result of flying off course to dodge a storm.

"We aren't exactly lost," I remarked cheerfully to Hans Groen-

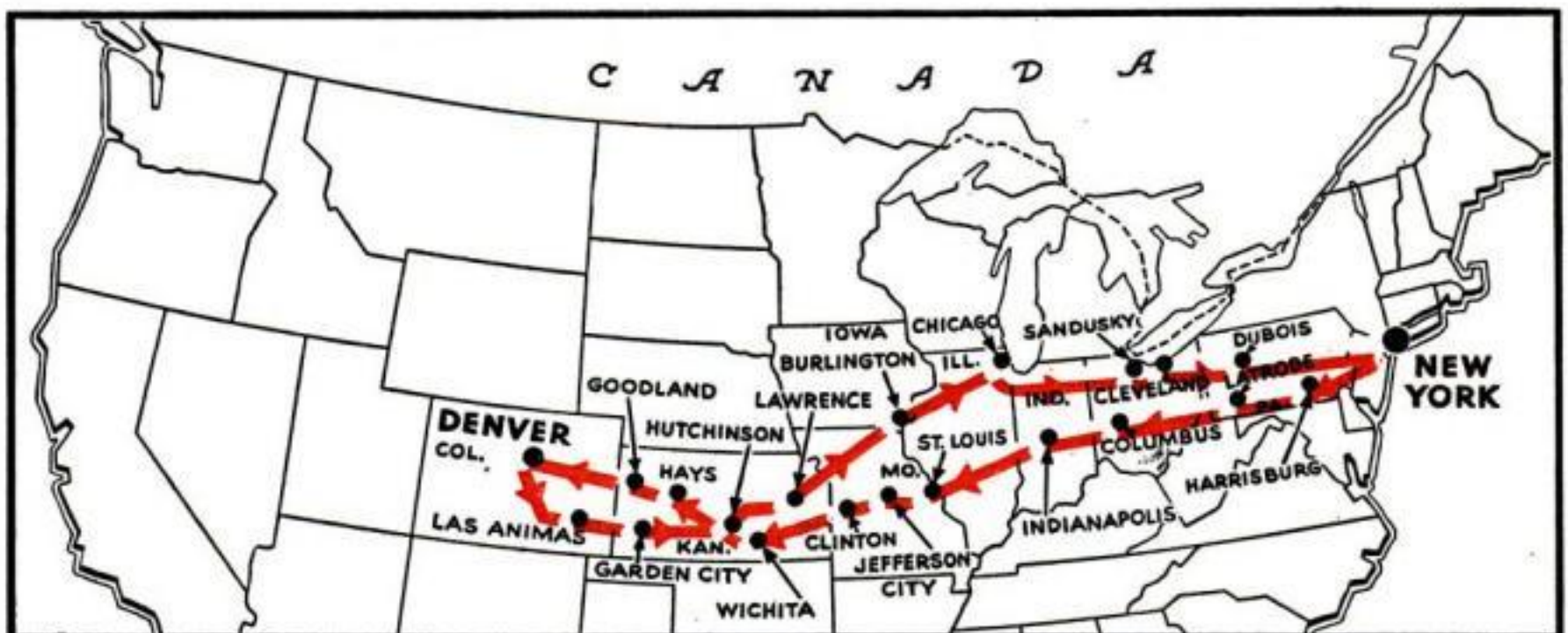
hoff, photographer and copilot. "We just don't know where we are."

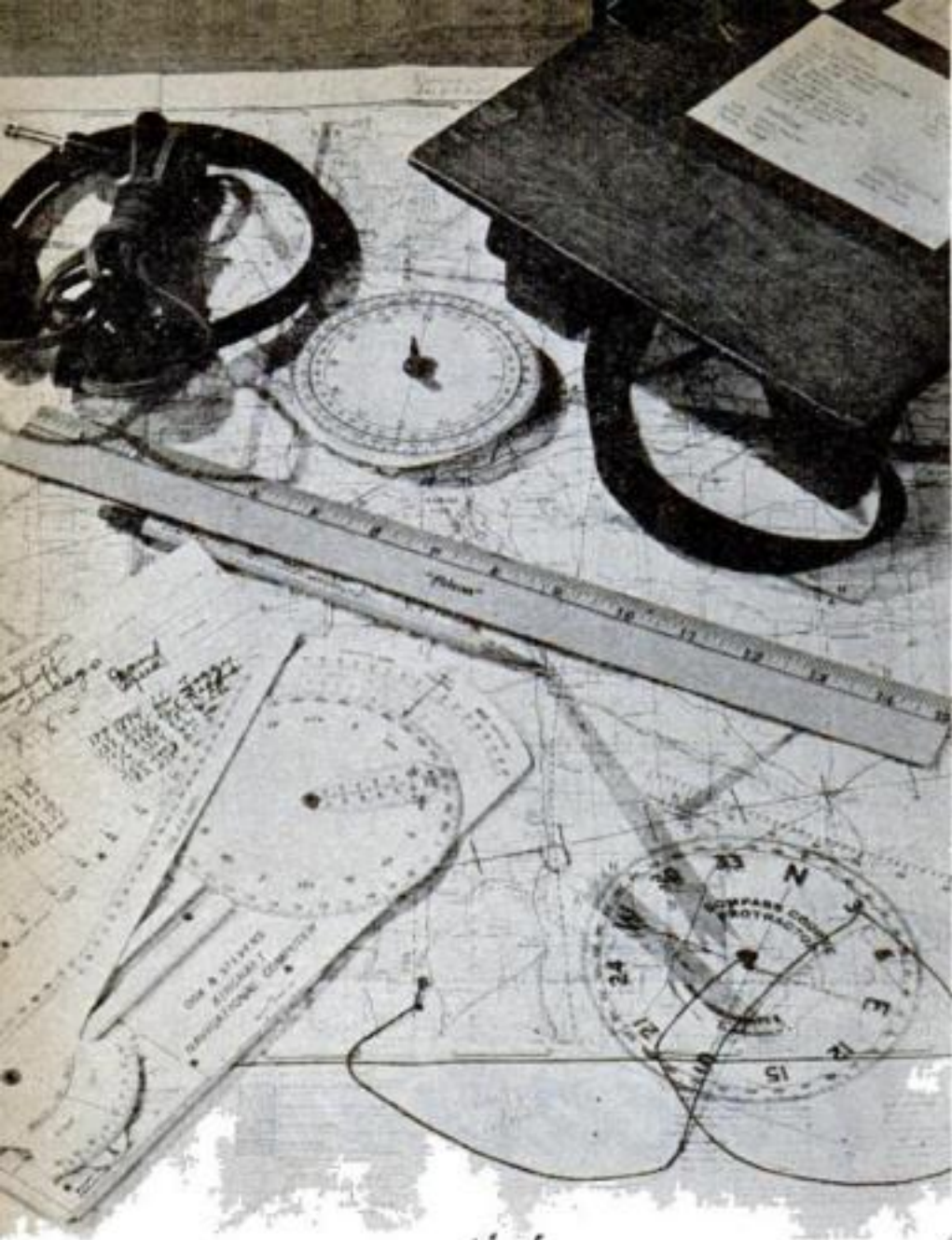
Even with our rudimentary knowledge of weather, we knew we had to keep clear of that storm. Luckily enough, it was the first one we had met in our more than 1,500 miles of flying from New York. We knew that inside it were winds of hurricane force. Even several miles away from it the air was choppy. The plane was pitching.

"If it will make you any happier," said Groenhoff, "look."

PART 2

He pointed off in the direction op-





FLYING AIDS used in piloting the Aeronca Chief included a navigational computer, ruler, pencil, protractor, flight-record slip, airman's map, another protractor with reciprocal readings for quick compass orientation, earphones for the radio receiver, and a Francis-designed kneeboard that is strapped to the leg to keep maps in view.

posite to the storm we were skirting. There sat a pile of purple-black clouds with a narrow ribbon of dirty gray at their base. If we were to miss this second storm, we would have to alter course again. We did. Then we spotted a third storm. In several years of flying I had never encountered anything like this. It took us fully an hour to maneuver our way into the clear.

"I think we're off the map," said Groenhoff. "We must be somewhere in Wyoming."

"No, we're not," I replied. "Look ahead of you."

I used to live in Colorado. Some snow-capped peaks spired up on the horizon. They looked familiar. We rechecked our position. After all our wandering around we were 30 miles northeast of Denver, practically on course. Another thunderstorm crowned the city as we neared it, so we cruised around on the outskirts until the air cleared.

That night we celebrated.

"A nice tenderloin steak," I told the waitress at dinner. It was small talk. We knew there were no steaks.

"I'm sorry," she replied. "There's no ten-

derloin—but I can give you a sirloin." It took me five minutes to bring Groenhoff out of a dead faint.

We vacationed. We fished in a mountain lake. We did some rubbernecking from the air. We lay on our backs in the sun. And before we knew it days had gone by. It was time to start home. We checked the weather. A cold mass of Canadian air was moving down from the north and spreading across the northwestern United States.

"I'd wait," said the Denver weather man. "if I were you."

We waited. We had to. We wanted to cut northeast to Chicago. "Ceilings" were coming down all over that area. After 24 hours we got impatient.

"Let's leave," said Groenhoff. "We can cut south of our course." I was as anxious as he was to get away.

We had broken our rule again about avoiding major air terminals, because Denver Municipal Airport was the only place we could find hangar space. Now, as we sat on the concrete apron abutting the hangar, gassed up and ready to go, the control tower grew curious.

"The ceilings are down east of here," it told Groenhoff by radio. "Where are you going?"

"We'll check in at Hugo," said Groenhoff into the transmitter, naming a town 90 miles southeast of Denver.

That was just close enough to the truth not to be a fib. We would land at Hugo if we had to. The control tower had no authority to keep us aground so long as the ceiling and visibility were all right at Denver. It was just trying to be helpful. In turn, we didn't want to be a worry to anybody. We only wanted to get away.

Twenty minutes out of Denver we hit it. Fog stood like a wall from ground to sky. We turned southeast. The fog stood spread-legged in our path. We turned south. Here it was clearer. But the terrain was coming up.

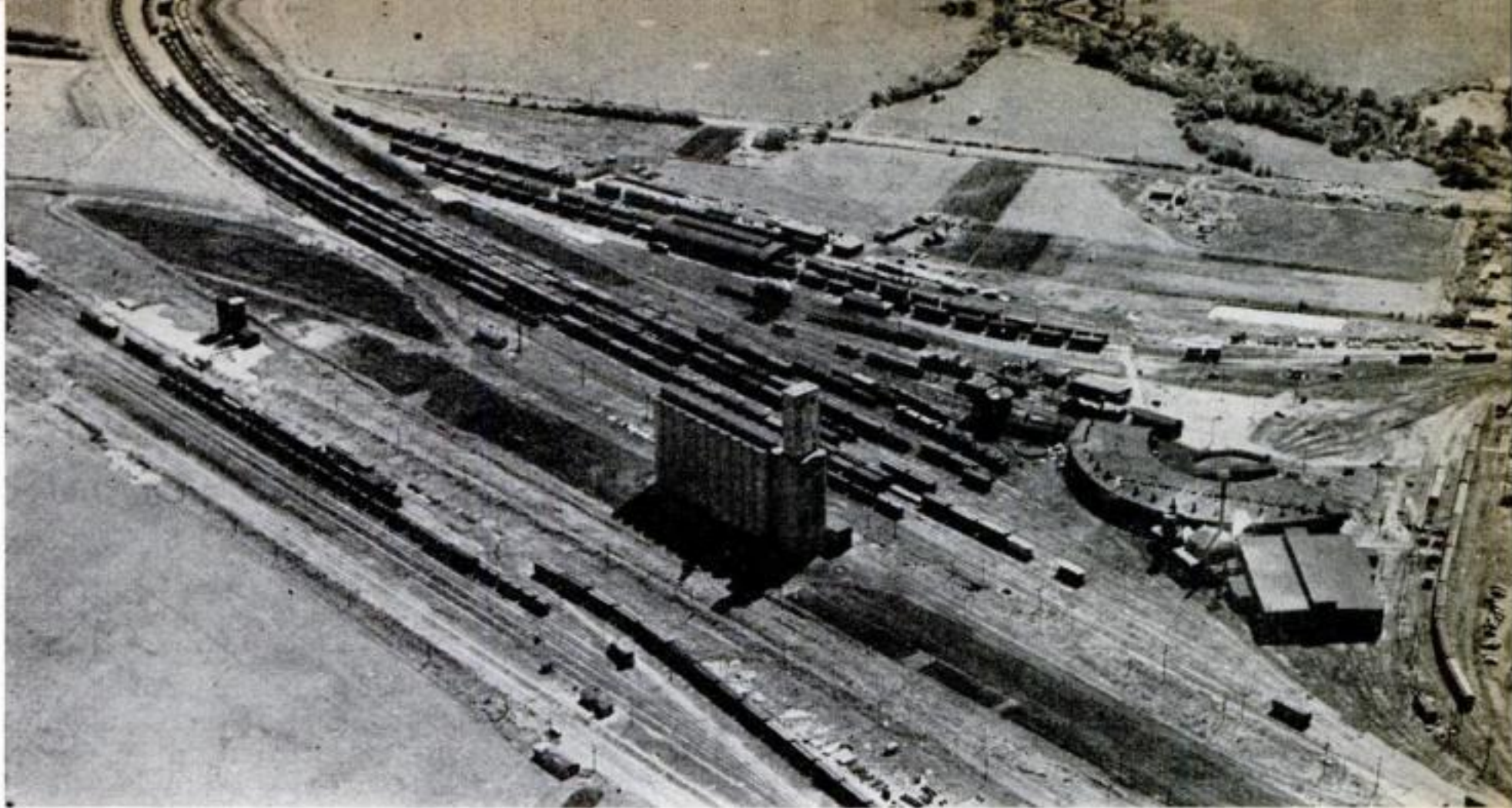
"Want to go back?" asked Groenhoff. "No."

This was the very area, east of Colorado Springs, that a Civil Air Patrol captain in Wichita had told us to shun. The hills were almost too high for us to clear them with the horsepower at our command. A 7,000-foot ridge swept by, barely 200 feet beneath us. The Aeronca, heavily laden and taxed almost beyond its capabilities, was reassuringly steady.

"I don't like this," remarked my companion. He was sweating.

"For me," I said, "you are understating the case."

We were lost again, but that was a secondary consideration. Our job was to keep



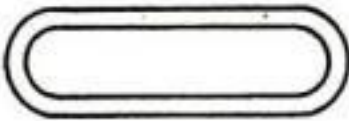
LANDMARKS are the guiding stars of the flyer who navigates by "pilotage." Some stick out like sore thumbs—for example, the rail yards at Wichita, Kan., (above) with an elevator and roundhouse standing out unmistakably. The oil field at right presents a characteristic pattern. To help "contact" flyers, Coast and Geodetic Survey maps prepared for airmen are filled with pictures and symbols like those shown below, identifying easily seen objects on the ground. Note that cities with more than 5,000 population are indicated by outlines representing the actual shape of the built-up area. If you follow a railroad, you must watch out that you don't get switched to the wrong track.



HOW PROMINENT LANDMARKS ARE SHOWN ON AN AIR MAP

Cities and Towns

-  Less than 1000
-  1000 to 5000
-  More than 5000 (actual shape)



Race Track



Forest Ranger Station



Quarry or Mine



Coast Guard Station








Lookout Tower



Oil Well

Highways and Railroads

-  Prominent Highways
-  Secondary Highways
-  Railroad (one track)
-  Two or more tracks
-  Abandoned



HELPING HANDS were extended almost everywhere, both by airfield personnel and by the local flyers. Here David M. Brown, the chief pilot for Mountain States Aviation, Inc., at Boulder, Colo., is helping the Popular Science flyers to patch a tire that had gone flat in landing. One hospitable airport operator even took Francis and Groenhoff out for a sightseeing trip in his own automobile.

AIRPORTS that could be seen and identified easily from the air were at a premium. One of the best was Norton Field, at Columbus, Ohio (below). Many of the small fields were so effectively camouflaged that our flyers had to give up after a fruitless search and go on to another. Government fields are uniformly well marked and maintained. Private airports often are poorly marked because the owners just aren't interested in transients.

out of the fog and find lower ground. We knew the Arkansas river lay south of us, and on that we could orient ourselves.

The hills got lower. Then the river, silvered by a shaft of sunlight, appeared ahead of us.

"Maybe that radio will work," said Groenhoff. He fingered the dial, listening hard at the earphones.

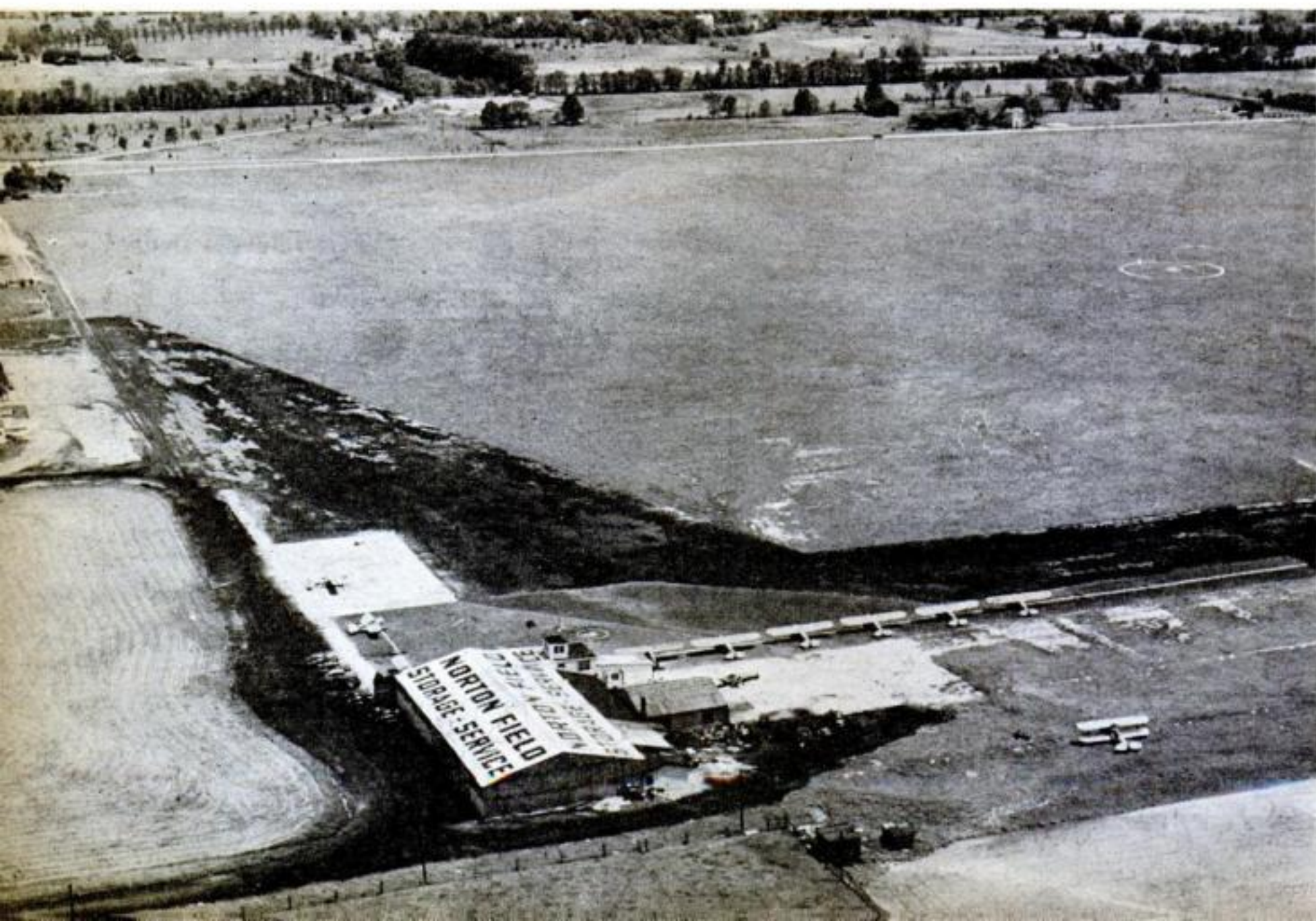
"I'm getting the 'N' signal on the La Junta frequency," he announced. He put a finger on the map. "We're about here."

After more than 1,700 miles the fact that the radio would pick up the beam signals was a pleasant discovery. It was sheer idiocy not to have tried it out before. We turned east, landed at Las Animas, Colo., refueled, and hurried on to make up time.

Weather forced us to put in at Garden City. We were 100 miles south of our alternate course to Chicago, but at least we were on our way. We helped roll the ship into the hangar and taxied into town. That night we took stock.

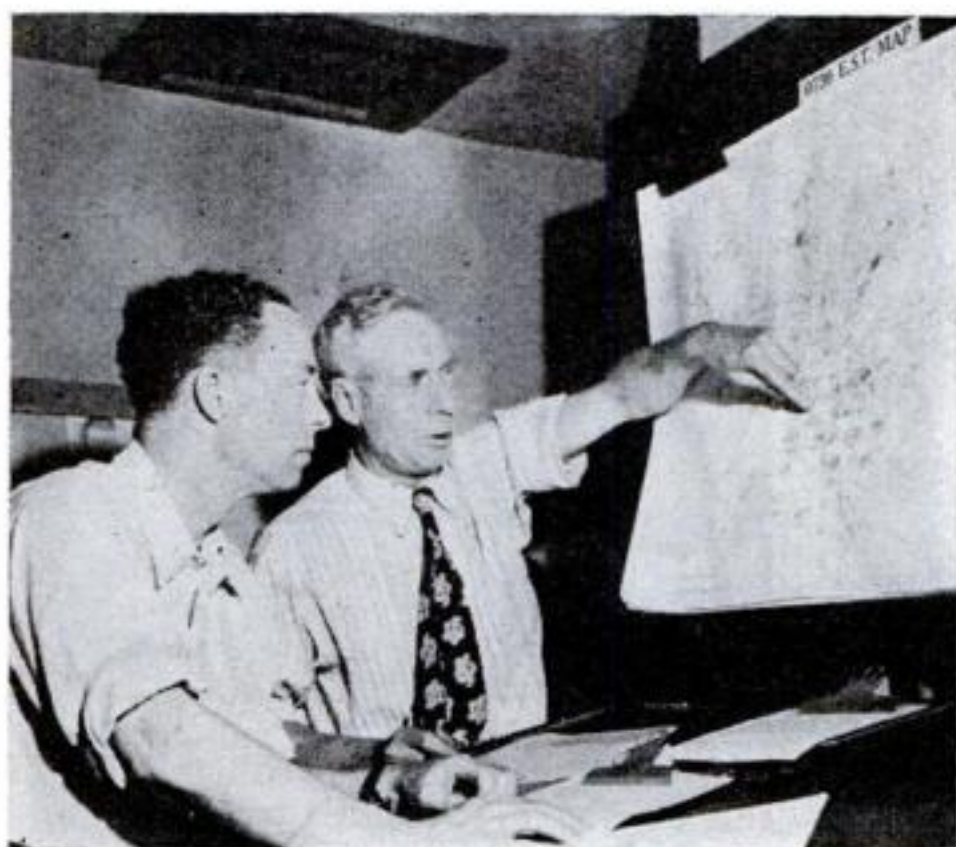
"We should have stayed on the ground in Denver," Groenhoff summed up. I agreed. "That cold air mass moving down from Canada," he went on, "is overriding a lot of warm air and causing fog and rain. This is no weather for airplane riding."

I supplemented his observations. "We crossed railroads and several highways. If they had been identified at 10- or 20-mile intervals so they could be seen from the air, with an arrow pointing to the nearest airport and the mileage specified, we wouldn't have got lost."





STORM. Here is one of the few good pictures ever made of a thunderstorm from the air. At the lower right, a ribbon of rain is seen between the cloud and the darkened earth, while the sun is shining near by. In the photo at left Arthur R. Magee, Federal meteorologist at Goodland, Kan., warns Francis of thunderstorms gathering ahead.



"Amen," said Groenhoff. "With two men in an airplane working hard at flying and navigating, and still getting lost, what is the casual flyer going to do when flying becomes more general?"

We decided something else: In addition to big identifying marks on airports themselves, each airport needed a circular fence of arrows, at least 20 miles in diameter, pointing to it. And, of course, every hamlet should paint its name in 50-foot letters on a roof or in a public park. Only then would cross-country flying become as effortless as automobiling.

If the weather didn't clear entirely, at least it was less stinko, as Groenhoff put it. We bored eastward. At Hutchinson, Kan.,

we were squared away to land when I spotted some cattle on the field.

"That can't be the airport," I said.

We found it, but only after another hunt. By now we were past the point of getting aggravated. Besides, to be truthful, we were getting too much enjoyment out of the flying itself to get irked by the inconveniences. We were watching each other like hawks on sharing the flying time.

"It's my turn in the left seat," I announced after we were gassed. "That's right," Groenhoff agreed reluctantly.

We checked the weather through the Hutchinson Navy airfield. The ceilings were not good but we played it safe. We followed railroads, confirming our visual observations with the radio receiver. If the weather had got thick, we could have raced to an airport and sat down. Carefully we marked every airport on and near our course that could serve as an emergency haven.

We passed up Topeka in favor of a small airport at Lawrence. Here we ran into a new one. A huge sign on the sloping roof of a barn read *(Continued on page 207)*

What's New in Modern Living



PLASTIC SCREENING, pliable, rust resistant, water repellent, and sturdy, is being manufactured now for all household uses to which metal screening has been put in the past. That shown in the photo above is a plastic window mesh marketed under the name of Saran screen.

NONSLIP hangers for dish towels, aprons, and the like, promise to cure the vexing habit these kitchen items have of falling off the rack. The Ketchook, manufactured by the Plastic Die & Tool Corp., of Los Angeles, holds the article securely yet allows it to be removed simply by lifting. It is said to embody a new principle of operation and is made in a variety of colors to match kitchen color schemes. The device is fastened to the wall by means of two screws.



BATHROOM AND KITCHEN accessories now on the market include a combination 4" by 18" glass shelf and 16" wood towel rack made by George Koch Sons, of Evansville, Ind. Brackets and rod have a white, washable finish.



WAKE UP TO MUSIC with the help of this electric clock that turns your radio on or off at any preselected time. It can be used to time many household appliances, and is made by the Warren Telechron Co., of Ashland, Mass.



GLASS SERVICE SETS for breakfast juices include a bowl for holding ice cubes to keep the contents cold. George Sakie, of the Fostoria Glass Co., is the designer.

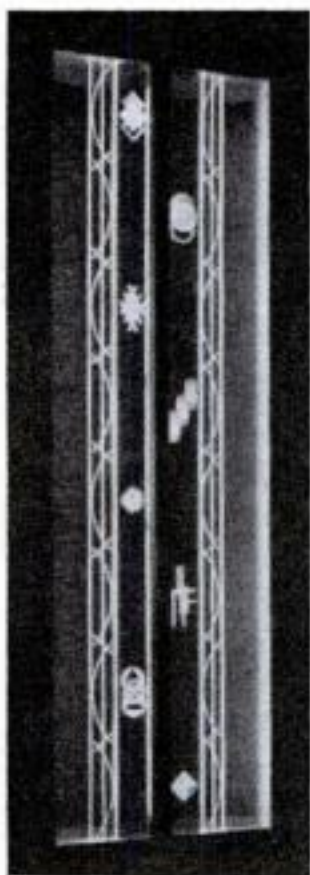
DOUGHNUTS ARE SHAPED automatically simply by pressure on a pump when dough is put in the pint-size aluminum device shown at right. The unit was developed by the Crosby Research Foundation.



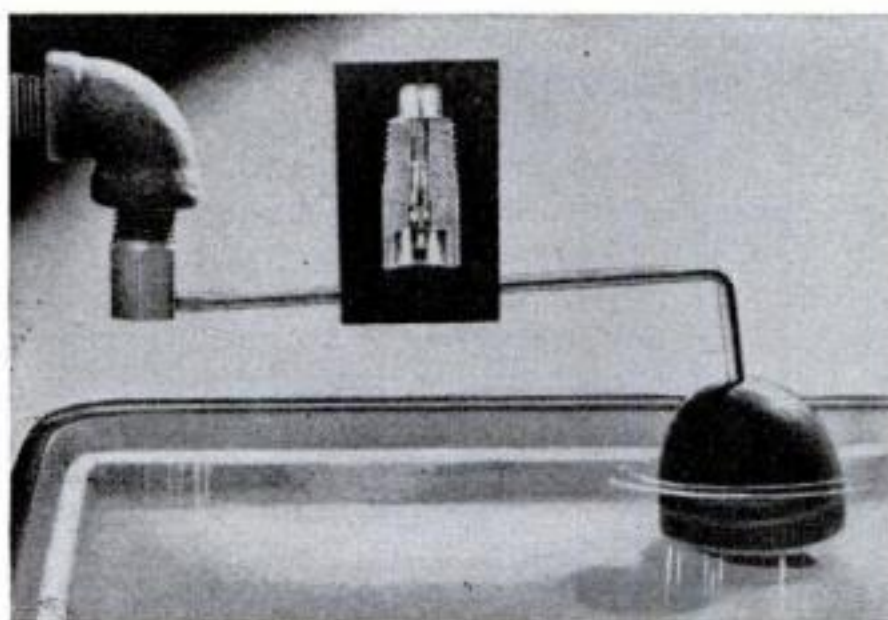
OF INTEREST TO HOME OWNERS

DECORATIVE lighting methods have been getting attention from manufacturers of fluorescent lamps and fixtures, as can be seen from the typical units illustrated here. Realizing that the bare and unattractive installations now in use can be applied only to the service parts of a house, designers have turned to adaptations of concealed and circular lights. Some of the novel and interesting effects that can be obtained through the use of recessed fixtures are suggested in the composite view at the upper right. Of special importance is the trend toward employing lighting as a functional part of modern furniture. The designs pictured here were worked out by Westinghouse lighting engineers.

Panel fronts are also expected to play



a part in softening the glare of luminous tubes and helping them to harmonize with the color scheme of a room. The picture at the left, supplied by General Electric, illustrates an interesting color-blending fixture designed by C. T. Masterson. Three types of plate glass are used to filter the light, and the bright edges are obtained by beveling the rear surface to 45 deg. All the installations shown here employ tubes of small diameter.



THIRSTY PETS will always find water in the trough if you let the Sim-Pléx Automatic Float Valve remember to fill it for you. Recently announced by A. D. McBurney, of Los Angeles, the valve maintains constant water supply in pans or tanks and is suitable for poultry, farm, or household uses.

BATTERY CASES converted into paving blocks make an unusual back-yard walk for Fred W. Fletcher's San Francisco home. Some years ago, Mr. Fletcher took several hundred discarded storage-battery cases that were on hand at his service station, filled them with sand and cement, painted half of them white, and laid them out as shown. They have outlasted many concrete pavements in the neighborhood.



Gus Cures a War Headache

By MARTIN BUNN

"HEY, boss," Stan Hicks said with somewhat forced breeziness. "I've dug up a new customer for you!"

Gus Wilson's expression was noticeably lacking in gratitude as he regarded the Model Garage's grease monkey and blossoming mechanic. "Well, now, that's just dandy," he told him sarcastically. "Here I am working four or five evenings a week trying to keep our regulars happy, and you go out and dig me up a *new* customer. I'll tell you what, Stan—get out your shovel and cover him right up again!"

Stan grinned sheepishly. "Well," he admitted, "maybe I'd ought to have said that this party is a sort of personal friend of mine, and would you do me a favor and take a look at—"

"Who is he?" Gus interrupted.

Stan's face got red under its habitual coating of grease. "Well," he stammered, "it ain't a he—it's a she."

"Oh," Gus smiled, "so that's it?"

"No, that ain't it!" Stan protested. "I used to go to high school with this Barbara Milligen. She's always been car crazy, and ever since she was a kid in freshman class she's been saving up her dough to get herself one. When she got a job in a war plant about a month ago she had to have a bus, so she took her coin out of the bank and bought an old sedan from one of those big used-car dealers down in the city. She ain't as dumb about cars as most girls, but it looks to me like they sold her a quince. Can I bring her in? She's outside now."

A minute later a much-shined-up 12-

year-old green sedan was driven into the shop. Gus noticed that its tires were good and that its engine was running smoothly. Stan got out on one side and a red-haired girl with a flock of freckles and an expression of concentrated fury got out on the other. She looked at Gus unsmilingly and announced: "I wish I'd never set eyes on this junk wagon, and I'll bet you will, too, after you've worked on it."

"Don't mind Barbara, boss," Stan put in diplomatically. "She's always been a sour-ball."

Barbara's green eyes blasted him. "Keep out of this, jerk!" she snapped. "I'm talking to Mr. Wilson."

Stan's feelings were outraged. "Yeah, you're talking to him because I did you a favor getting him to bother with your broken-down old bus!" he yelled. "And now the gratitude I get—"

Gus laughed. "Don't quarrel, kids," he advised. "There's no sense in getting sore at a car, miss—I've done it hundreds of times, and it never did a bit of good. Suppose you tell me just how yours has been acting up and what you've done about it."

Barbara's face crinkled into an attractive smile. "O.K., Mr. Wilson," she agreed. "Well, I knew enough about cars—mostly from always wanting to own one—not to expect to get a super-duper de luxe job for what I paid—and I didn't. I did expect something I could drive back and forth to the plant without continual trouble—but I didn't get that either."

"The first few days, it ran fine. Then the battery got weak, and one morning it didn't have enough kick to turn the motor over. I had it recharged, but the next week it ran down again, and the man at the garage said it must be the generator. He went over it and put in new brushes and everything, and nicked me plenty. Inside of a week the battery was down again, so I took the car back to the place where I'd bought it, but they wouldn't do anything—and got fresh about it, too."

"I have to be in a car pool, of course, and every time it's my turn to drive I have a lot of trouble getting started—and usually we're all late for work. The others in the

"I wish I'd never set eyes on this junk wagon," she said.





When it was her turn to drive, they were usually late. The others in the pool were beginning to get sore.

pool are sore and say they'll drop me if I don't get my car fixed. Others will hear about it and won't want me in their pools, and I'll have to give up my job—and, believe me, Mr. Wilson, those fellows fighting in the Pacific need what I'm helping to make!

"Well, while I was wondering what I could do," she went on, "I ran into Stan, and here I am. I'll have to leave the car here—my shift goes on at four o'clock. I can take a bus to the plant, and coming back tonight—"

"Never mind about tonight," Stan told her. "If we can get your car fixed, I'll drive it over and pick you up at the gate, and you can drop me at my house on your way home."

"Why, Stan, that's real nice of you!" Barbara said.

"Oh, well—I haven't got anything to do

tonight," Stan muttered in embarrassment.

Barbara's green eyes blazed again. "If that isn't just like you!" she cried. "You always spoil everything by being so—so *ungracious!*"

"Scram!" Gus shouted. "You two do your scrapping outside. I'm a busy man."

Five minutes later Stan came back grinning and found Gus checking each cell of the battery of Barbara's car with a battery voltmeter.

"They're all run down a bit, but they test even, so there can't be anything much wrong with the battery," Gus commented when he had finished. "Guess we'd better take a look at the cutout."

Finding nothing wrong there, he turned to the generator. So far as looks told, it was in excellent condition, but when he checked it he found that it wouldn't charge the battery properly until the engine was

turning over at a speed rate of 40 miles an hour.

"There it is," he told Stan. "Your friend Barbara's battery runs down because the generator doesn't charge it while she's driving. The juice that's drained out isn't replaced. Well, we've found the cause of the trouble; now we've got to find the cause of the cause. Take the generator out and put it on the test bench."

Stan did as he was told. Gus put in 10 minutes going over the generator carefully, looking for mechanical defects which he didn't find. Then he hooked it up with the test-bench drive motor for an electrical check. When the tachometer showed that the generator was being driven at a speed of about 600 r.p.m.—corresponding to a car speed of about 10 miles an hour—it began to charge, and as Gus gradually increased the drive-motor speed to 1,400 and then 1,800 r.p.m., the ammeter hand moved over to 10 and then to 12 amp.

Gus looked puzzled as he switched off the drive motor.

"There's nothing the matter with this generator," he told Stan. "It works perfectly when it's driven by the test-bench motor, so there's no reason why it shouldn't work perfectly in the car. But it doesn't! Well, we'll try again."

They reinstalled the generator in Barbara's car. Then Stan stepped on the starter and gradually increased the engine speed as Gus checked the generator output.

"Switch her off," Gus directed after half a minute. "It's exactly the same as it was before. The generator doesn't start to charge the battery until the engine is running at almost 40. There's something screwy here—and maybe it's me!"

Staring at the generator, he slowly filled and lighted his pipe. After a couple of puffs, he snapped his fingers loudly.

"That might be it," he muttered. He copied the generator serial number on the back of an envelope, went over to his workbench, and reached down his service manual from the shelf above. Then he checked the serial number against the generator numbers in the manual. Stan was peering over his shoulder.

"It's the right generator for that model car, all right," Gus said. "The same generator is used on several other makes, too—

but look here! A lot of the parts of this generator are interchangeable with the parts of other generators made by the same manufacturer. Maybe that's it!"

"Maybe *what's* it?" Stan demanded.

Gus didn't answer. He went back to Barbara's car and again examined the generator. Suddenly he laughed.

"There's the cause of Barbara's grief," he told Stan, pointing to the generator pulley. "And maybe I'm dumb not to have spotted it half an hour ago—especially since I ran up against the same thing just last year. I must be slipping."

"Huh?" Stan grunted. "I don't get you. What's the matter with the pulley? It looks O.K. to me."

"There's nothing the matter with the pulley," Gus told him, "except that it's much larger than the one called for by the specifications for this car. Naturally, the larger the pulley, the slower the generator is driven and the more engine speed is necessary to make the generator charge the battery. This pulley is so large that this generator doesn't start to charge until the car is being driven close to 40 m.p.h. Your friend Barbara probably never drives fast, so her battery never gets recharged."

"I get you," Stan said. "But what I don't get is how this oversize pulley got there."

"Like a lot of other headaches," Gus explained, "that's a result of war shortages. Auto electrical concerns are reconditioning all types of generators these days, and when you send in one for service or exchange you run the risk of getting back the right type of generator with a pulley of the wrong size on it unless you are careful to specify the car it's to be used in. Evidently when Barbara's car was reconditioned for sale, the right generator was picked up, but the man doing the assembly didn't notice the size of the pulley. That's an easy mistake to make. On a secondhand job the fan belt usually is old and stretched so much that it will easily slip over an oversize pulley before the generator is tightened."

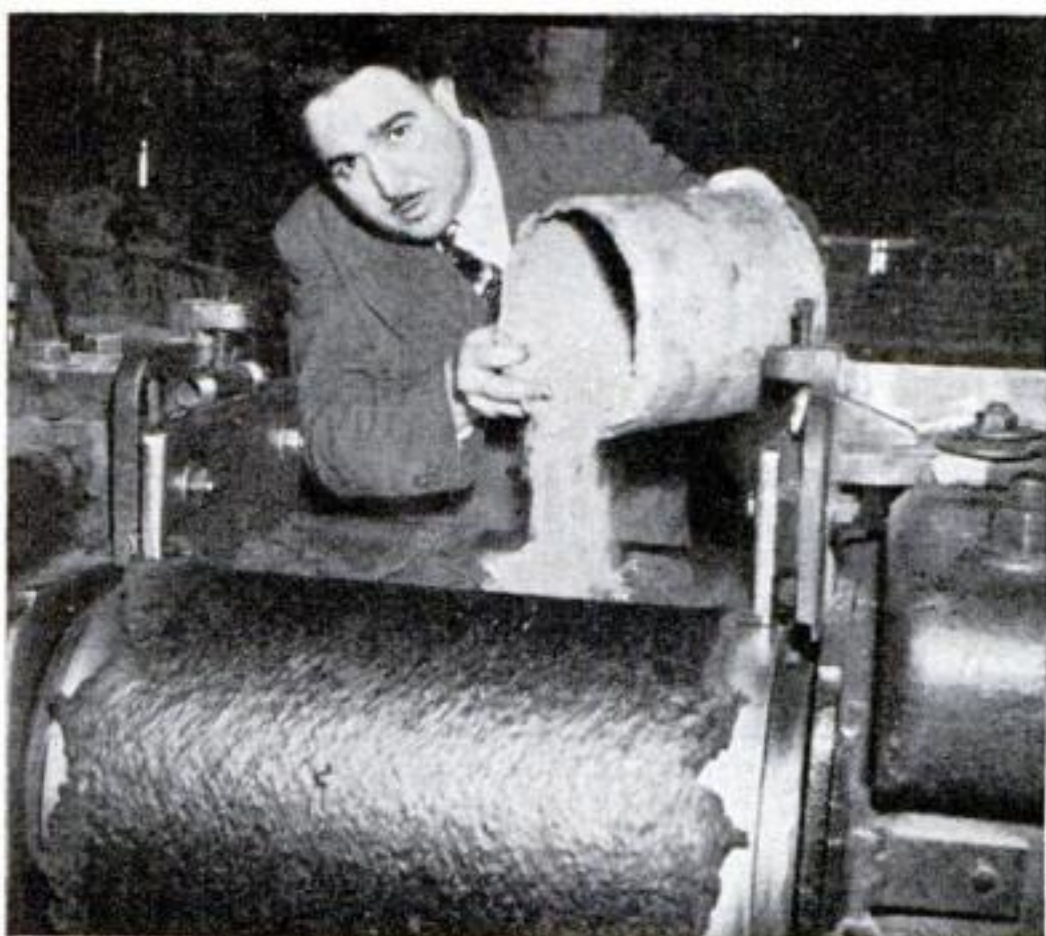
"I'll find a pulley of the right size in my junk box. You put it on, Stan, and then take the car over to Barbara and tell her about it. That'll give you something to talk about while you're driving home."

"O.K.," Stan grinned. "You can depend on me to take all the credit."



"If we get your car fixed," Stan told her, "I'll pick you up at the gate."

AUTO IDEAS



Sawdust spread over soft rubber in the process of retreading gives the tire greater traction.

ORDINARY SAWDUST eventually may relegate tire skid chains to the limbo of crank handles. Seeking a method of giving tires better traction and eliminating chains, Clarence and Lonnie Gapen, of Morgantown, W. Va., experimented with a number of materials and finally settled upon sawdust. With the cooperation of the Andy brothers, who operate a tire shop in Washington, Pa., they developed a milling process by which sawdust is worked into the camelback used for retreads. In tests, the tires carried an auto up a 12-percent snow and ice-covered grade without difficulty, and started and stopped the car on the hill without skidding. Rubber companies now are making tests to see if the process increases mileage.

FORGED IN ONE PIECE, a new jack developed for passenger cars by John M. Westrate, of Detroit, has no movable parts to slip or get out of order. After the head has been fitted against the brake drum, the auto is driven forward or backward until the

jack is resting vertically on its broad base. When the job is done, another short movement of the car frees it. There is no interference with removal of the tire or rim. Secured to the wheel with a safety strap, the device also can be used as a mud hook.

Inserted between the brake drum and rim, this one-piece jack raises the wheel off the ground when the car is driven either forward or backward.



At the top, a sawdust camelback is applied. Bottom center is a normal retread. At the right, a sawdust recap after 8,000 miles, and at the left a new one.



WHAT'S COMING IN CONVERTIBLES

Will they go the way of the touring car and roadster, or will they soon join the mass-production parade?

By CHARLES T. PEARSON

CONVERTIBLES have always appealed to young drivers and to the sports-minded who like clean, racy lines and a low center of gravity. If new tops—some of them ready for production and some still on the designers' drafting boards—are any indication, this appeal is due for considerable extension into the ranks of conservatives.

Probably almost everybody likes an open car, but prewar conservative drivers often held back because of admitted disadvantages—such things as rattles, drafts, top material that faded and lost its shape, and imperfect provision for getting the top up and down.

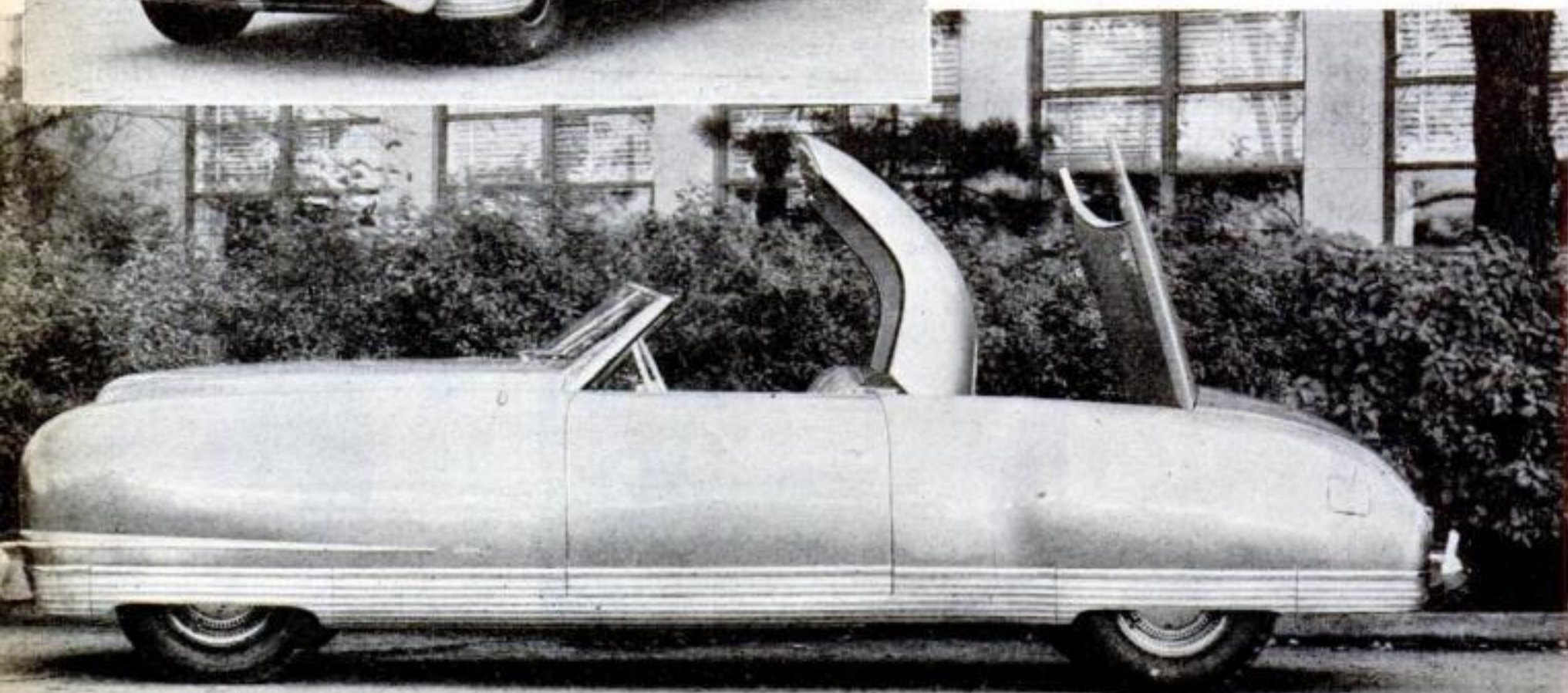
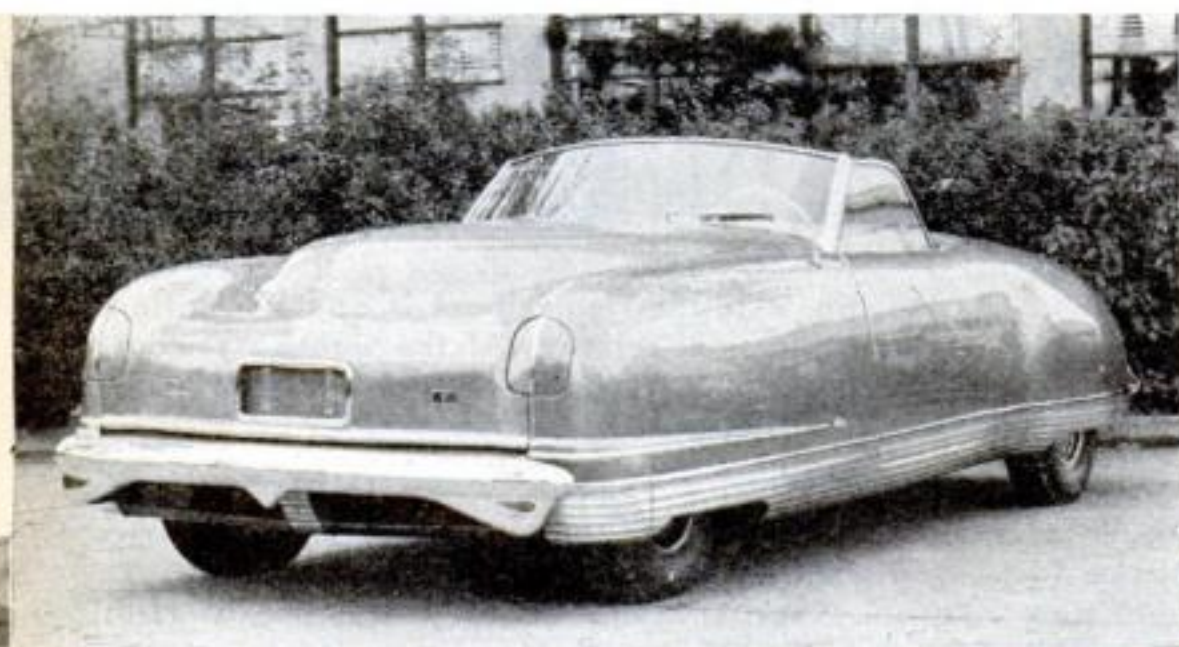
But the new open cars will be minus most or all of these disadvantages, and many in the automobile industry think the time is coming when the convertible not only will be the second car in most garages but the only car in many. Convertibles were estimated at 2 percent of the total production before the war, and prices ranged from \$100 to \$250 above those of closed models. As-

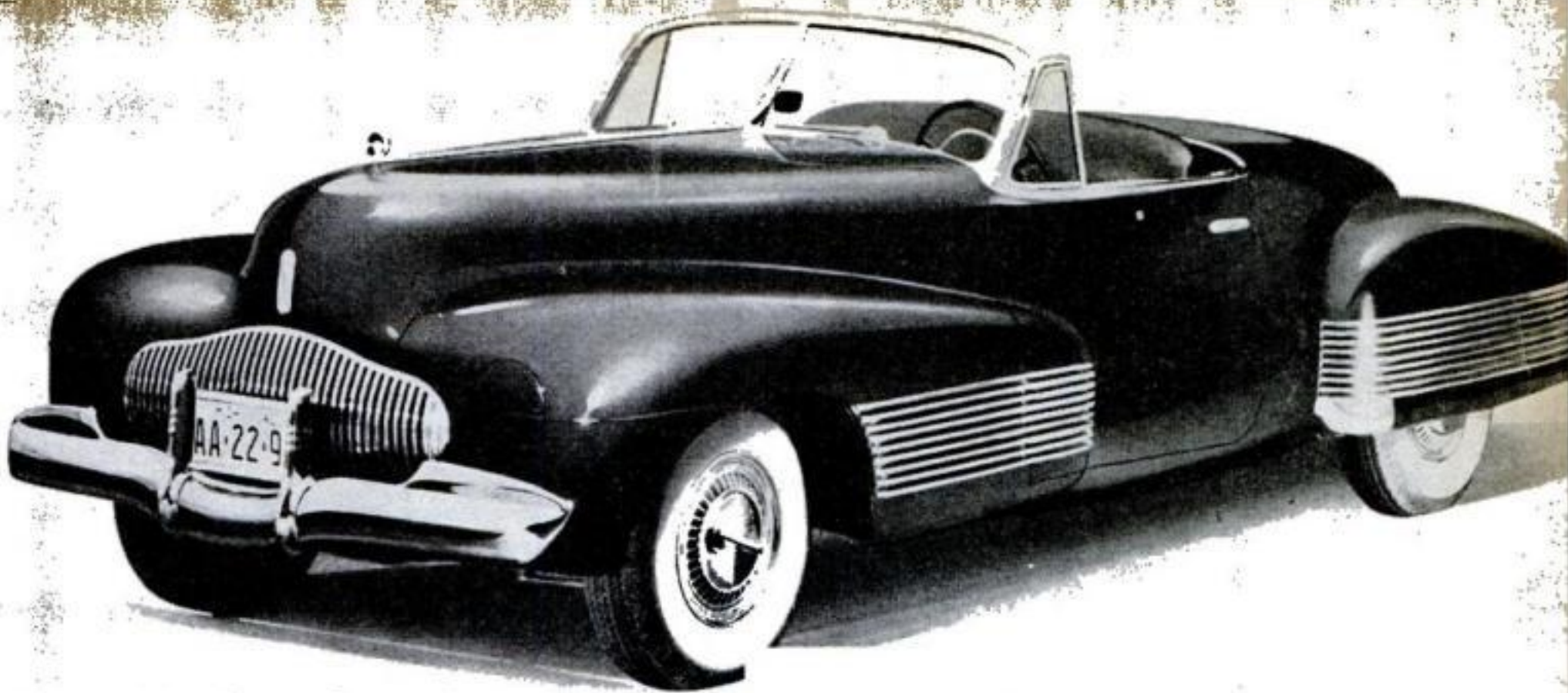
sembly-line production is expected to bring the price down nearer that of closed cars.

The push-button or power-operated top is a certainty, with hydraulic controls bidding for first place over electric and vacuum mechanisms because of the small amount of space required for actuating cylinders and because of the ease with which the power unit can be installed. A small 6-volt motor can be put in any accessible place and oil lines run to the hydraulic cylinders that operate the top bows and linkage. Oil pressure is so controlled that motion will stop if an obstacle is struck, and the mechanism can be operated manually whenever necessary.

Top designers predict that future convertibles will be engineered as a unit instead of as in the past, when little more was done than to cut off the top of a standard model and add a cloth top. With the new top made part of the car before it leaves the drafting board, a convertible with its top up will have the sleek lines of a streamlined closed car and its own racy open-car lines when the top is down. The back will have the hard-top curve, side windows will be larger, and the rear window will be as large as that of a closed model. Designs for large rear windows

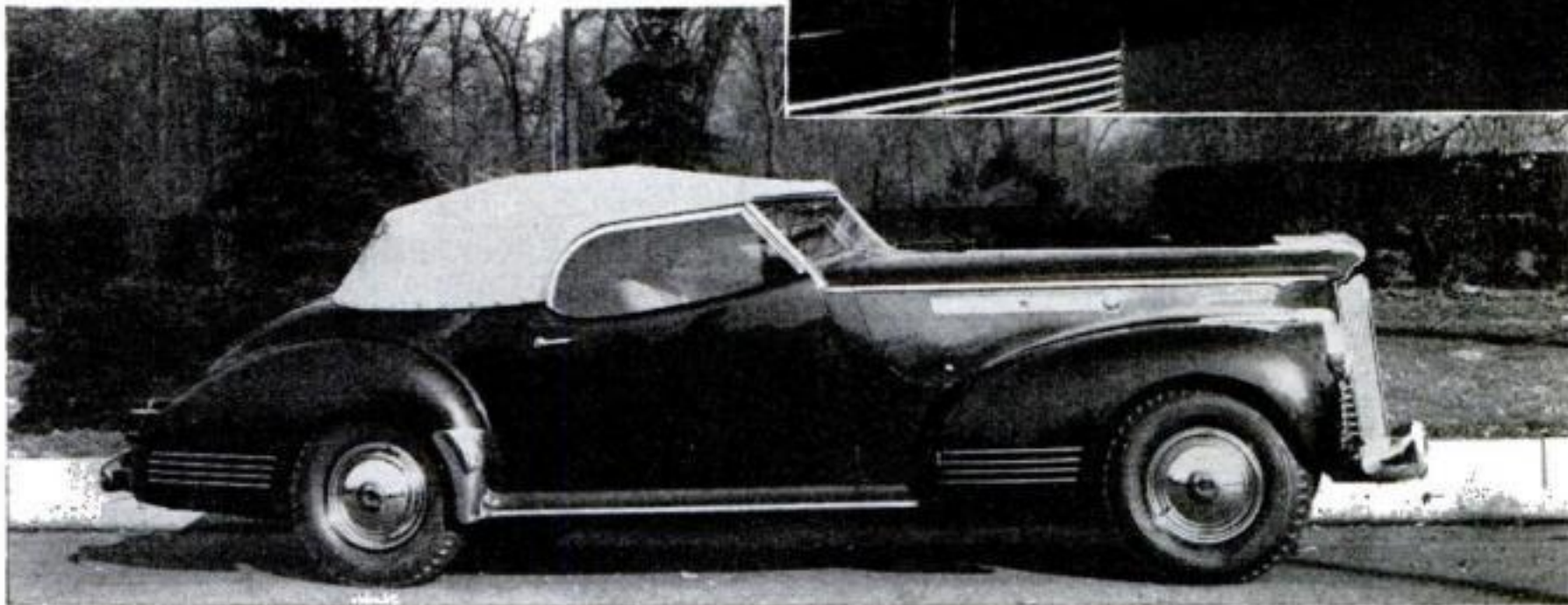
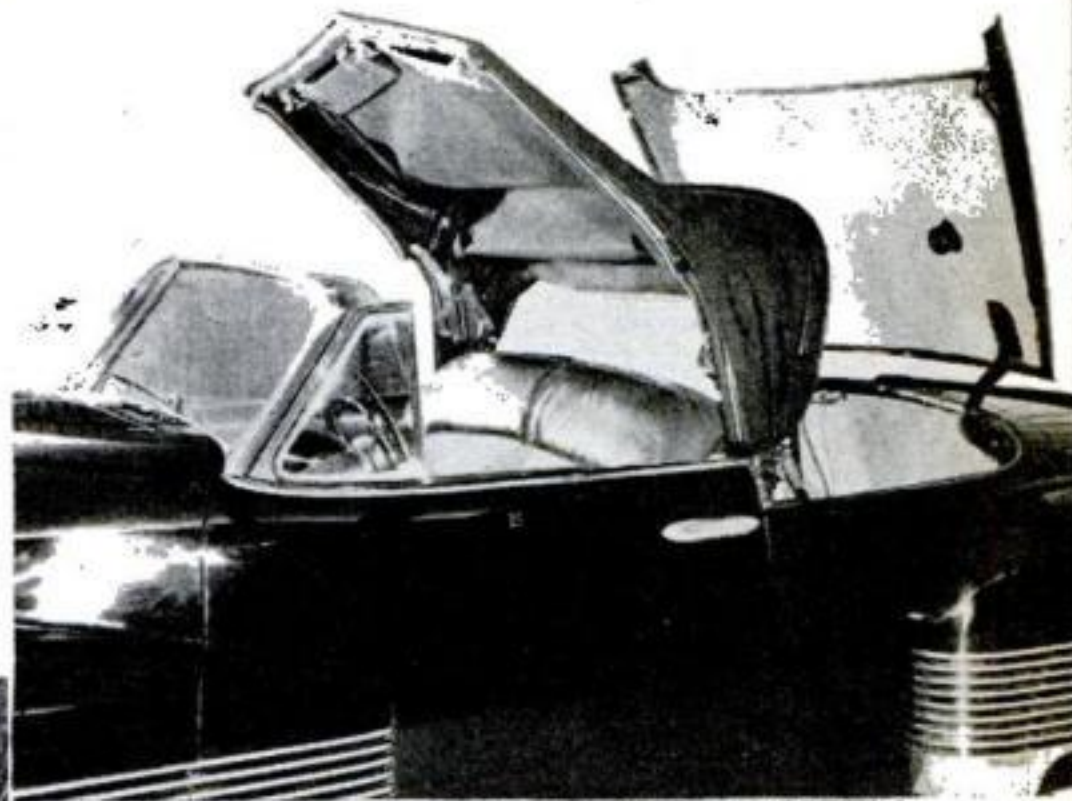
Chrysler's Thunderbolt, with its hard top down at left and partly up in the photo below. This is an experimental model. The one-piece top lowers into the rear deck where it is concealed. Up, it adds to the sleek appearance.





Buick's Fireball has a modern automatic folding top of the push-button type. The car was built in 1940 by Harley Earl, G.M. styling chief, and Buick engineers as a "style laboratory on wheels." At right, the top is shown partly up along with the rear-deck panel that conceals it. The panel and top work together automatically.

Below, Packard's prewar convertible by Darrin. It has an automatic top that fits almost flush with the deck when down to accentuate the sweep of the curve of the Continental-styled door.

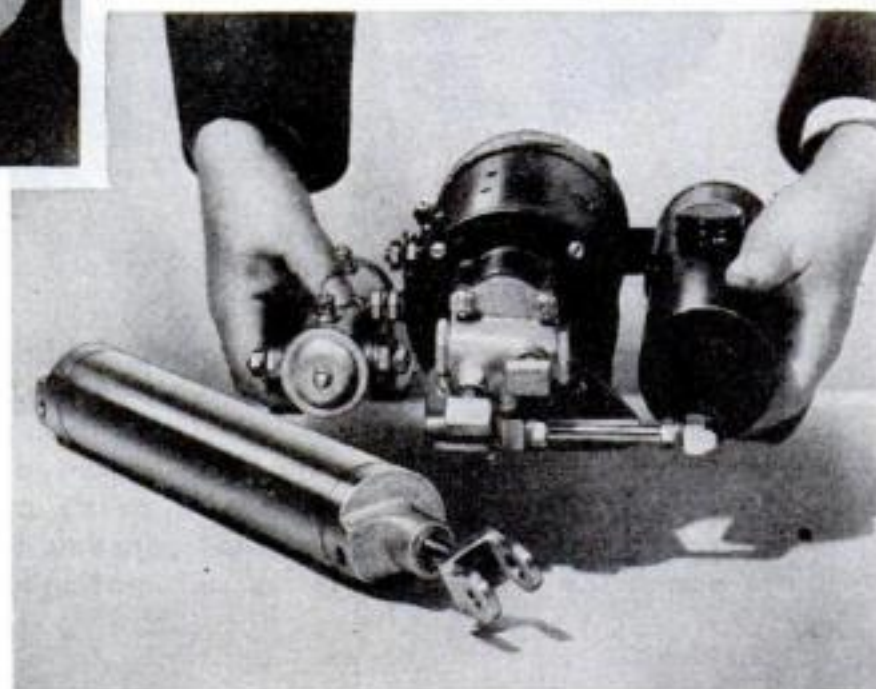


have already been perfected. Some lower into the rear deck at the touch of a button to allow open-car sweep of the breeze combined with closed-car protection against sun. One new rear window is designed for curved plexiglass and duplicates the sweeping lines of streamlined closed cars.

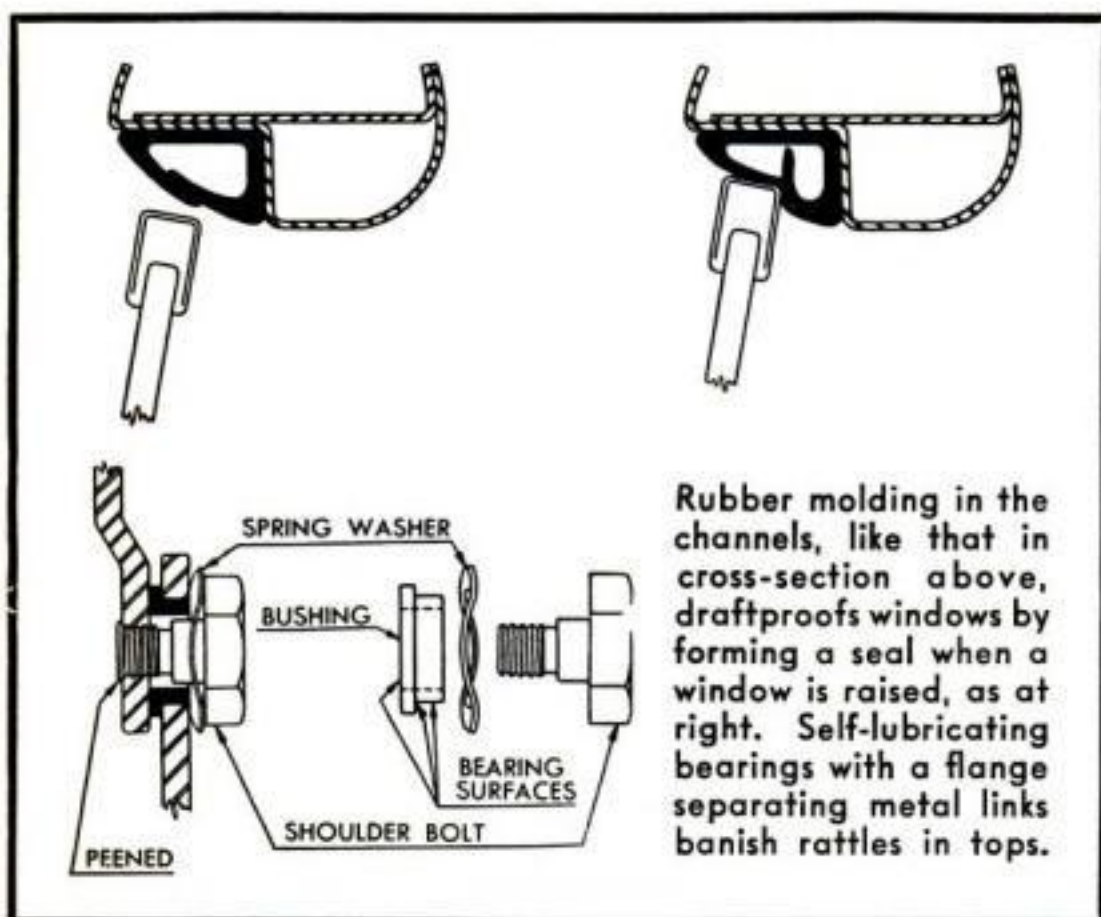
Control mechanisms have also undergone revolutionary changes since the day of the old "one-man" job that frequently resisted all efforts to be bent to the driver's will. Mechanically co-ordinated bows actuated by hydraulic cylinders now automatically fold

the top into place. Lighter metals, some developed in war production, reduce weight, and self-lubricating bearings stop rattles. Inside linkage is at least partially concealed, and the top is designed to make automatic, draftproof juncture with the body, windows, and windshield.

Fabrics are being improved, too, both for tops and all-weather upholstery. Synthetics and plastics are under consideration for tops, some of them opaque with bright, durable colors, some translucent, and some even transparent. The ideal top fabric will



Here is how a push-button top works. The phantom view shows the motor pump under the rear deck with oil lines to hydraulic cylinders and wiring to the control on the dash. At right, new framework with channel members for compact folding, and a close-up of a pump and cylinder.



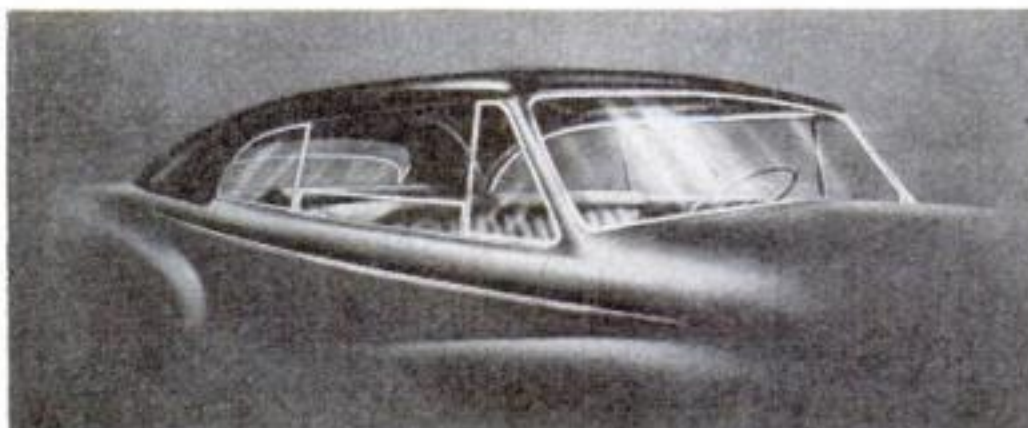
mental stage, but they may be offered to the public when car production gets into high gear. Design has generally featured a one-piece metal top over a single seat. A single-piece hard top for a club coupe requires a lot of room when lowered into the deck, and even the single-seat experimental models use space needed for luggage. One designer is experimenting with a hard top in sections automatically folded together by hydraulic control.

retain color as long as the body does; it will be waterproof and dirt resistant or easy to clean; it will be wrinkleproof or wrinkle resistant, capable of withstanding repeated folding; and it will be available in a variety of weaves and colors.

Hard-top models are still in the experi-

Most old-line manufacturers, and many dealers, too, were inclined in the past to look upon the convertible as expensive window dressing. But returning service men and women, accustomed to the exhilarating speed of open military vehicles and the clean lines of fast planes, will probably boost demand to assembly-line proportions. The convertible is decidedly here to stay.

New fabrics, synthetics, and plastics give the postwar convertible a smart closed-car look with the top up. At left, a translucent top; at right, an opaque model with a rear window that lowers into the deck.



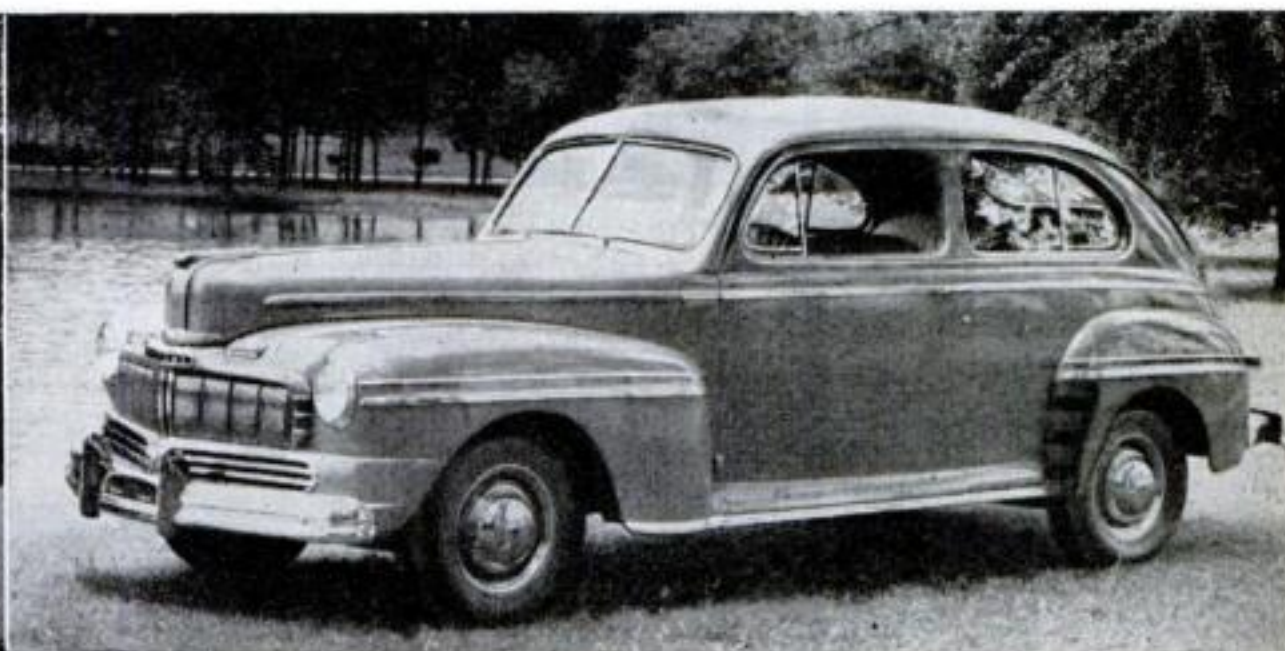
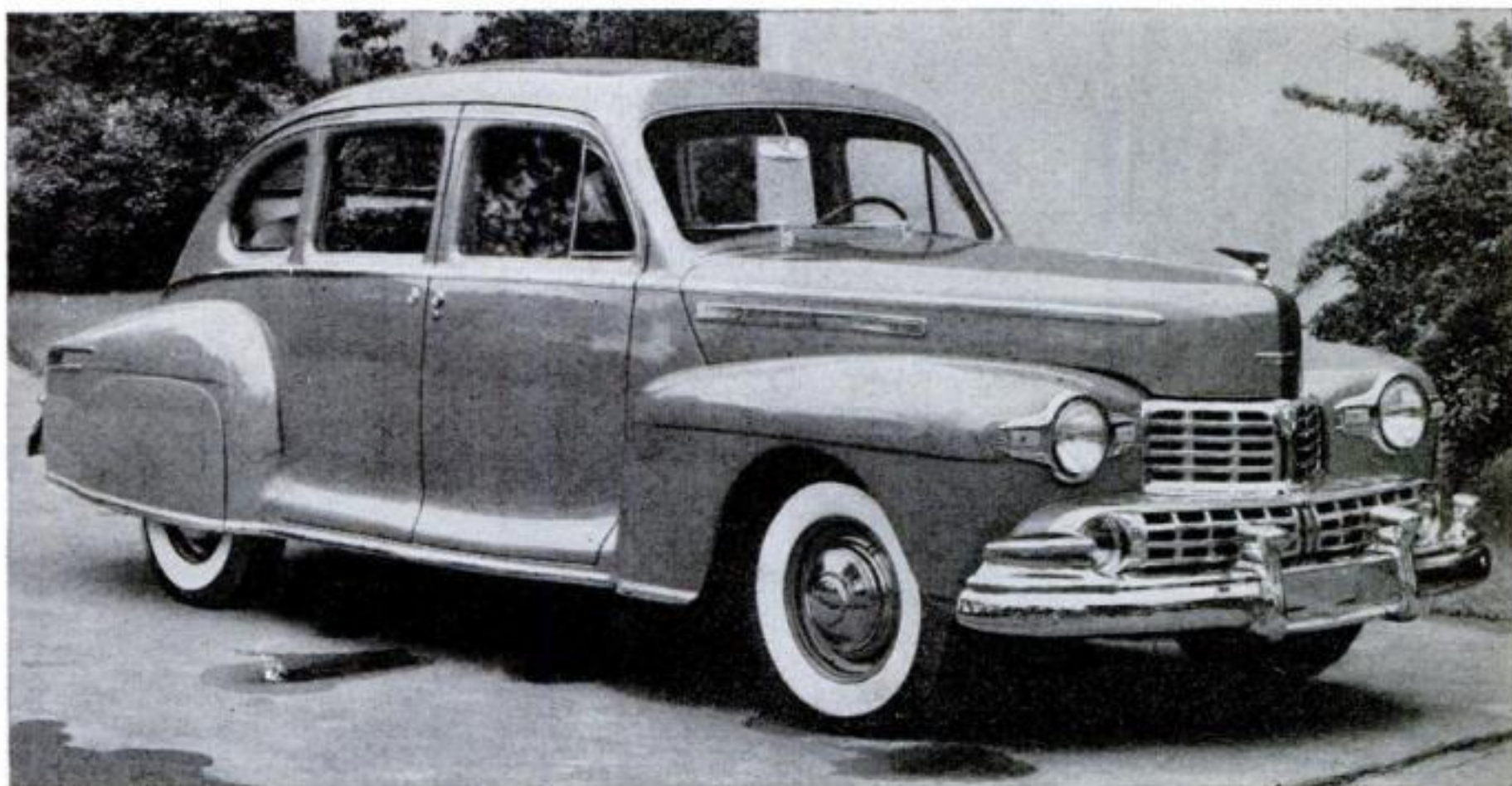
Details of New Lincoln and Mercury Announced

WITH the 1946 Ford already in production, the Ford Motor Company has completed its first models of the 1946 Lincoln and Mercury. The Lincoln has a new grille that makes the front appear lower and broader. Bumpers are wider, and fog lights are built in. An electrically operated hydraulic mechanism for opening and closing windows has been made standard, but the mechanical lift will be available as special equipment. Oil-pump capacity has been increased, hydraulic push rods have been improved, and the oil-pan capacity has been increased to seven quarts.

A lower, heavier, and wider-appearing

Mercury is also chiefly the result of a new front grille. Mechanical changes include triple-alloy bearings, crankcase ventilation, oil-type air cleaner, an oil cleaner, an improved oil pump, four-ring aluminum pistons and interchangeable cylinder heads.

The 1946 Ford V-8 engine develops 100 hp. as compared to the 90 hp. of the prewar engine. As in the past, a six-cylinder Ford engine will also be available. Many of the mechanical features of the Mercury have been included in the Ford, along with shock absorbers that have oil seals, foot brakes requiring less pressure, a Lincoln-type hand brake, and springs with more leaves.



Grilles of a new design help to give both the 1946 Lincoln and Mercury a broader, lower appearance. The new Lincoln, shown at the top, has a number of mechanical improvements, as has the new Mercury, directly above. Several mechanical features of the Mercury now are standard in the 1946 Ford, at the left. The latter already has gone into production.

GLASS-TOP COFFEE TABLE

WITH MAGAZINE BINS

By John Hugelmeyer

FROM two large-size cardboard photo-hypo containers, some plywood and leatherette, and a glass top came the maroon and ivory coffee table shown on the facing page.

If you don't go in for photography in a big way, discarded containers can be obtained from your local photographer. With a sharp knife cut shaped openings in them, as indicated in the photos, and then cut them to height. Leave the wood bottoms in place as tops, for screws can be put through them

to hold the plywood top in place. Strips cut 2½" wide from waste parts of the containers are glued in as shown to support a plywood shelf in each of the two bases. In cutting the shelf disks allow room for leatherette covers to pull over the edges.

Measure the exact diameter of the bases and sew up two sleeves of maroon leatherette to pull over them like stockings. The leatherette will stretch, so make the sleeves a little skimpy for a good smooth covering. Trim the opening with a razor blade, drill holes ⅜" apart near the edge, and lace with ⅝" wide strips of maroon leatherette.

Cover the plywood top with ivory leatherette tacked to the underside, and edge it with a 1" strip of maroon leatherette glued and tacked on over a strip of cardboard for firmness. This binding projects ⅛" above the plywood and serves to hold the glass top in place. It is best to make a pattern of the plywood top and have an expert glazier cut the glass.



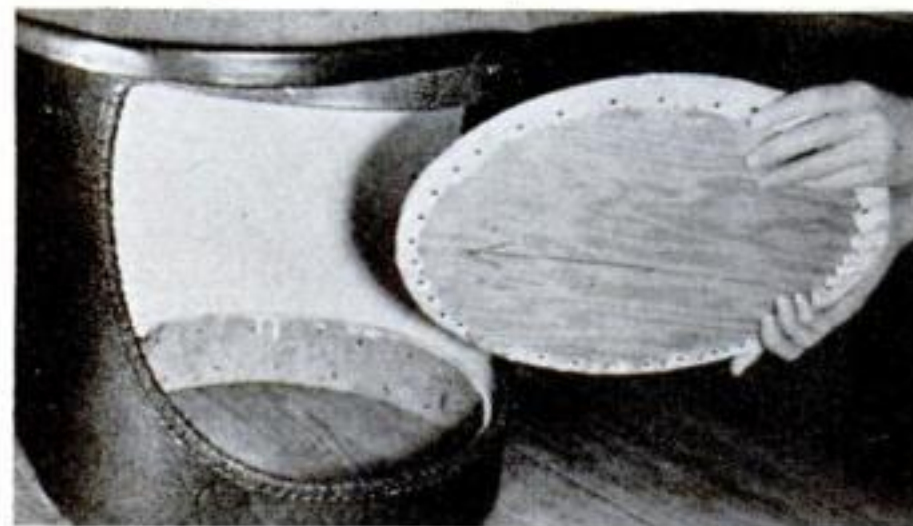
Photo-chemical containers with wooden bottoms are provided with openings and cut to a height of 15".

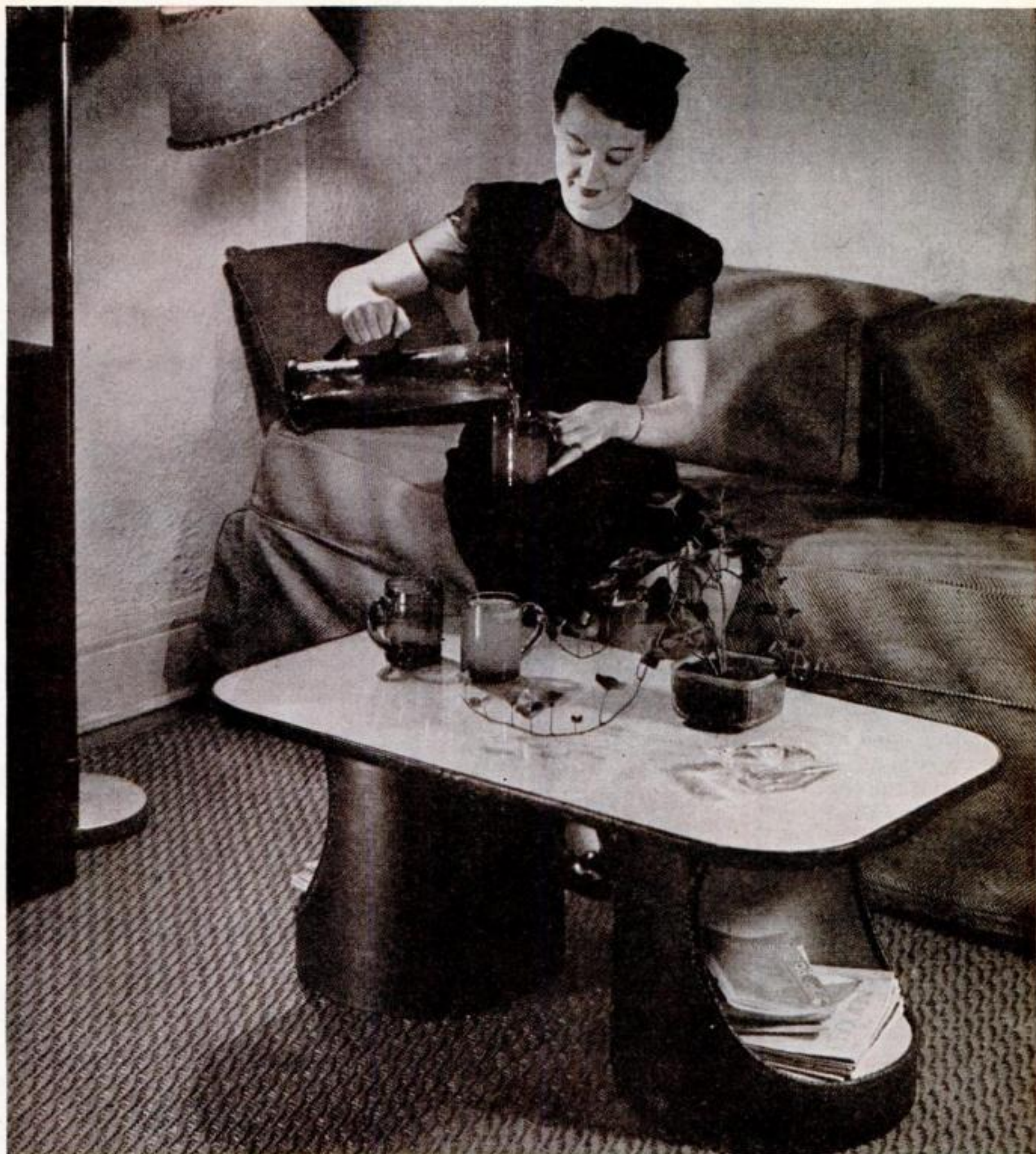


Disks are cut from ¼" plywood for a shelf in each container, and the insides are then painted ivory.

Strips from waste parts of the containers support the shelves, which take ivory leatherette covers.

Maroon leatherette is sewed to size, pulled on like stockings, trimmed, and laced at the edges.

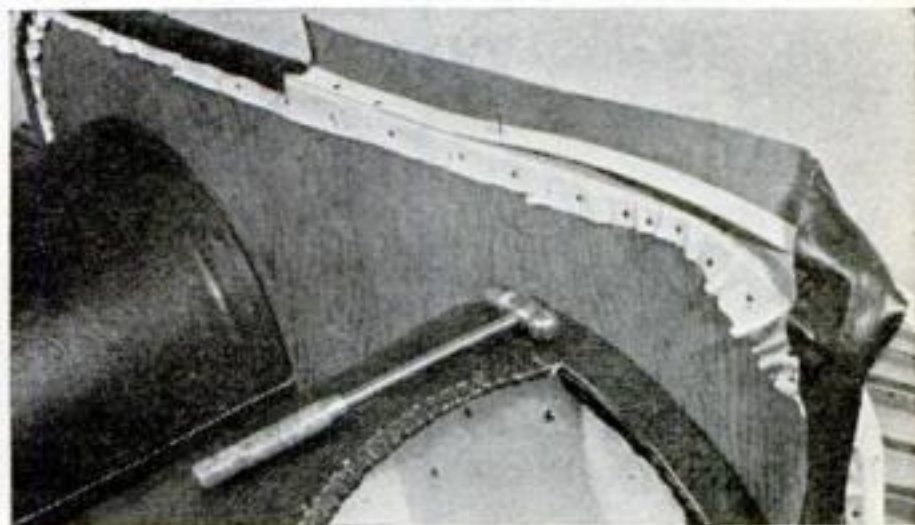
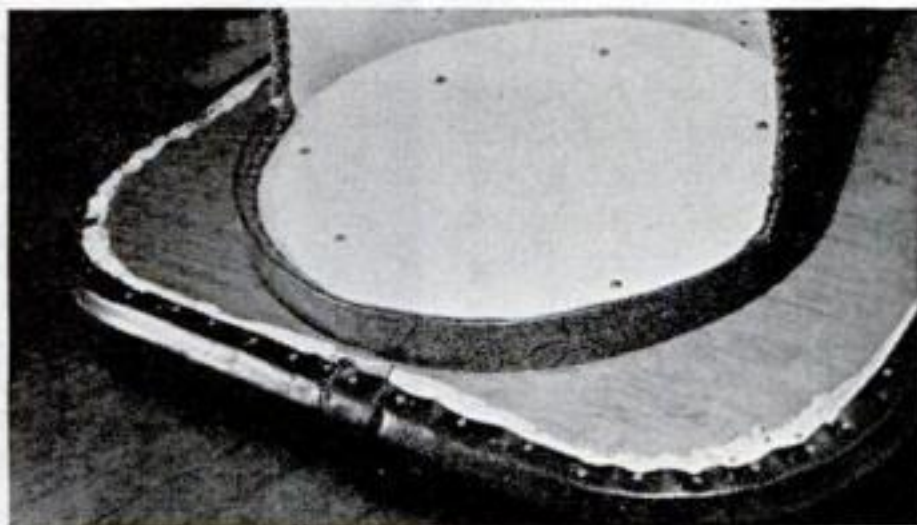




Glass over leatherette-covered plywood provides a fine, stainproof top. Bins in the base hold magazines.

Screws put through the wooden ends of the bases

fasten a $\frac{5}{8}$ " by 22" by 38" plywood top in place. Ivory leatherette covering the top is tacked on the underside and edged with maroon leatherette.

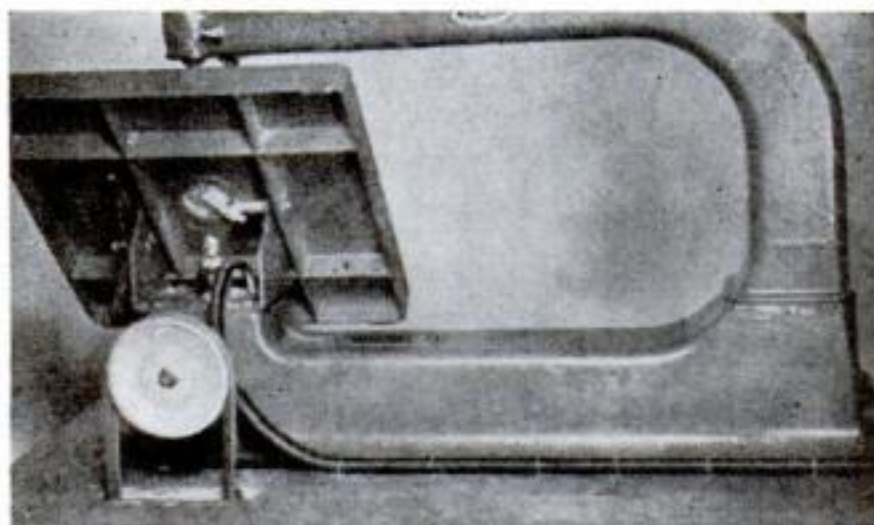
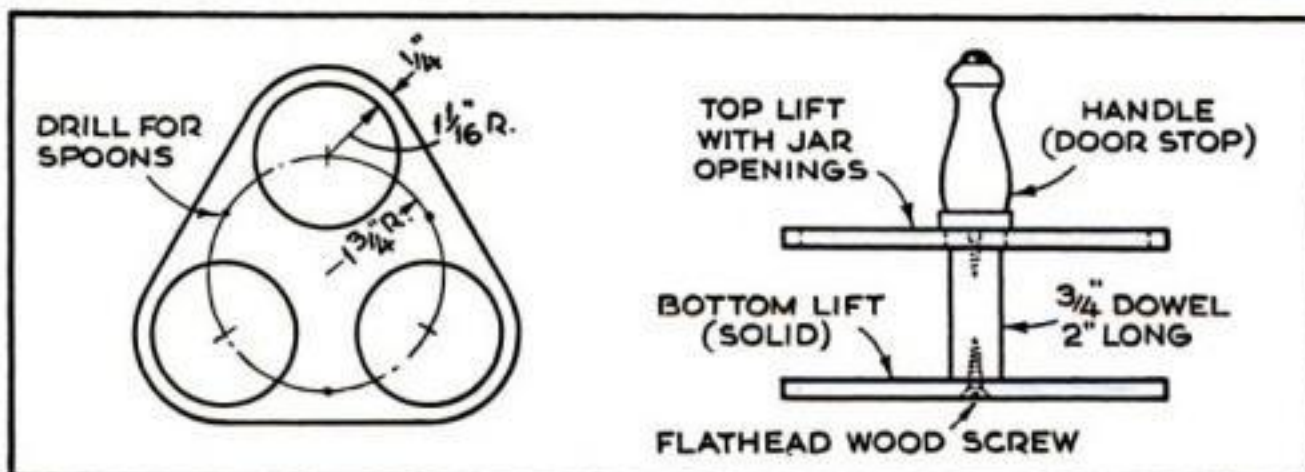


Jar Set Provides Simple One-Evening Woodworking Project

ANY HOUSEWIFE will welcome this jar set, which holds three kinds of spices, nut meats, candied peel, or confections. Designed for three of the 4-oz. jars in which prepared baby food is sold, it consists of two lifts cut from $\frac{1}{4}$ " wood, a door stop, and a $\frac{3}{4}$ " dowel 2" long.

A compass is used to lay out the top. Draw a circle with a radius of $1\frac{3}{4}$ " and use the same compass setting to divide it into six equal parts. At alternating points on the circumference, as indicated in the sketch, form three circles with a radius of $1\frac{1}{16}$ "—a size about $\frac{1}{4}$ " larger than the jars. Drill holes at the other three points on the circumference of the large circle to receive small spoons.

As a guide in marking the outer edge of the triangular piece, connect the outermost points of the three small circles with tangent lines. Cut out the top lift and use it to lay out the solid one for the bottom. Attach the lower lift to the dowel with a flathead screw and the upper one with the door stop, which thus serves as a handle. Paint the edges of the lifts and the tip of the handle any gay color.—VICTOR ROMING.



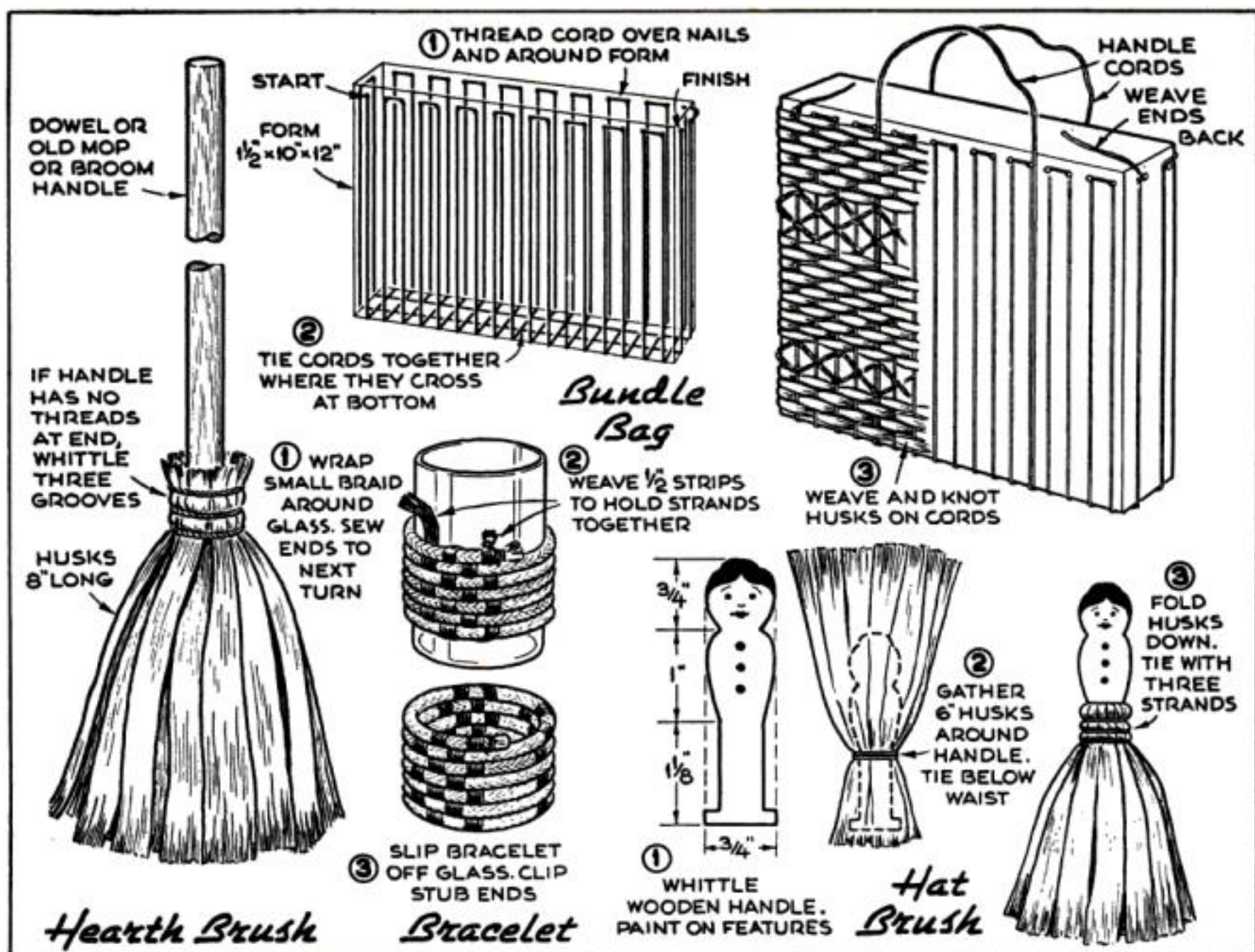
Tube on Crankcase Air Vent of Jigsaw Keeps Out Dust

CONSIDERABLE sawdust was sucked into the crankcase of the jigsaw shown in the photo because the air vent is located near the path of the dust falling through the saw aperture. This was finally prevented by attaching a rubber tube to the pipe of the vent and running it away from the dust area. The tube was kept out of the way by fastening it to the bench with wire staples.—BERTRAM BROWNOLD.

Your Dinner Guests Will Like This Homemade Place Favor

A POWDER puff and soda straws, cord and ribbon, and wooden beads—that's what this place favor is made of. The cord was run through the straws and knotted, then bent to provide joints for the arms and legs. From the legs the cord was extended through the skirt (a small powder puff) and the beads that form the body and head. After being tied around the hair ribbon, the cord was slipped through a hole in the top of the card. Features were inked on the head bead, and the skirt was sprinkled with sachet powder. A prop on the back holds the card upright.—B. N.





Husking Time Provides Fun and Projects for Fall Evenings

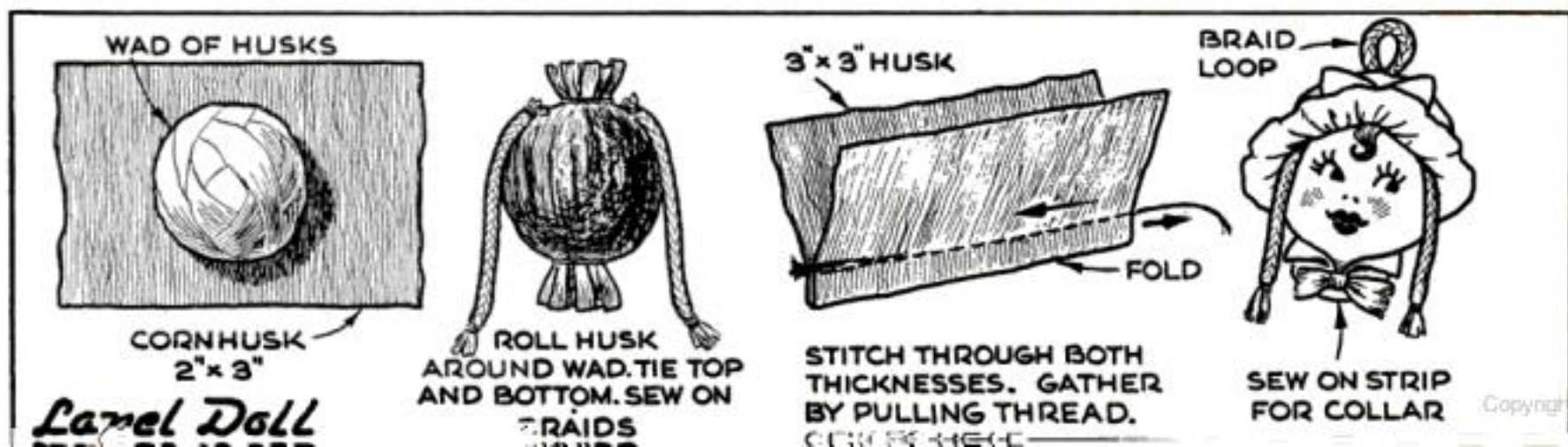
FIELD corn is in season and its abundant husks can keep farm families busy making useful and ornamental objects. City dwellers, confined to sweet corn at a dozen ears at a time, can save up husks for projects.

Cornhusks should be used damp. Cut off the butt ends, separate the coarse outer and soft inner husks, and cut them into strips of desired widths. For dyeing, soak them a few minutes in hot water, squeeze out the surplus, and then work them in the dye bath with your hands.

Coarse husks are used in strips for brooms and brushes, as shown. Soft husks for the bracelet illustrated, chair seats, and hot pads, and coarse ones for floor mats, are braided first—loosely for thin, flat projects or tight for thick ones. New strips are braided in as necessary. Keep the stubs on the underside and clip them close when the braiding is finished. Sew the braid into the desired shape and weave with strips of husks contrasting in color.

A useful bundle bag is shown above and on page 104. Wrap the cord around the nails, from side to side and then from end to end, tie at every place it crosses, and add a heavy cord for the handles. Weave with strips, weaving the bottom first and continuing on up the sides. Strips are added as needed by knotting. The diamond pattern dividing the woven sections is made by tying strips to the cord frame. For proper weaving, strips must alternate under and over each cord for its entire length, and therefore, so there will be an uneven number of cords, one of the handle cords is treated as a separate cord in weaving and three are grouped with the cord next to them. When finished, pull out the nails and remove the bag from the wooden form.

Husks wadded and covered by a soft husk, as shown below, make heads for both the lapel doll and the boy in the whistler-and-dog bookmark shown on page 104. The dog's head is a blunt triangle.—ELMA WALTNER.

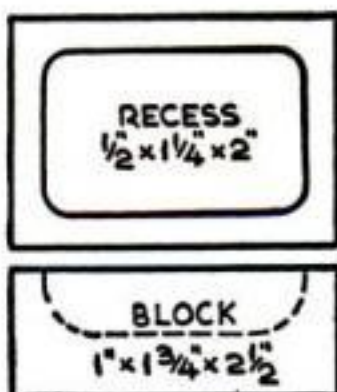
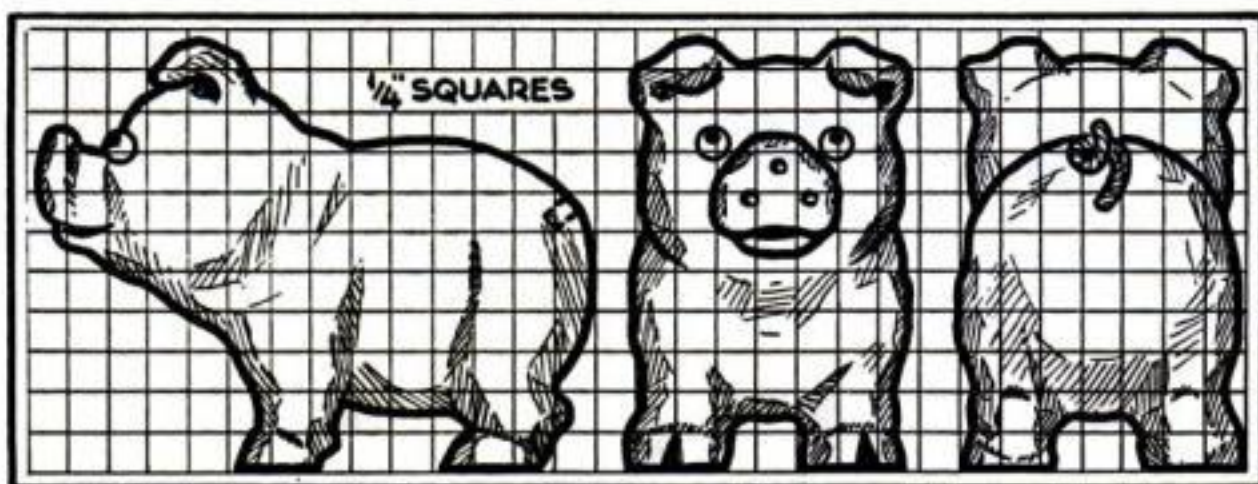


Whittled Pig in Desk Set Has Paper-Clip Trough

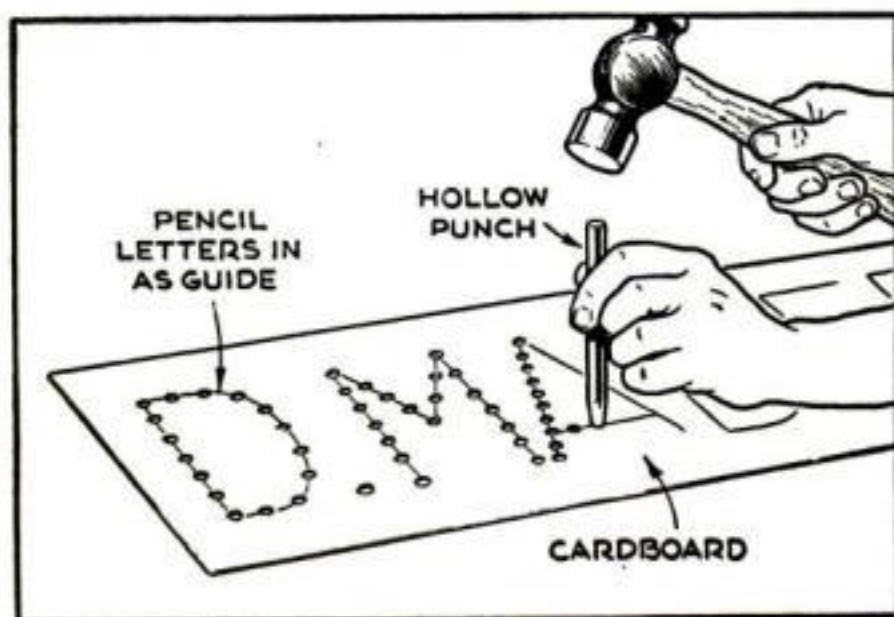
PAPER clips, not truffles, fill the feed trough of Percival, but the little pig's pudgy, upturned snout remains cheerful. For all his unusual diet, he retains that well-fed look so becoming to porkers.

Lay out the figure on a $1\frac{3}{4}$ " by $2\frac{3}{4}$ " by $3\frac{1}{2}$ " block of soft pine, and saw out the profile roughly to shape. The rest is done with a sharp jackknife, the stock being turned often to assure roundness and correct proportions. Sand off the rough spots, for you won't want even a young pig to be too angular. Then drill for the curlicue tail, which is a short length of pipe cleaner engagingly kinked and glued in place. Drill a small hole through the nose to hold a wire ring. Finish with a light oil stain, touching up the tail to match, and add white map tacks dotted with black for eyes.

The trough is a 1" by



$1\frac{3}{4}$ " by $2\frac{1}{2}$ " block hollowed out with a chisel. Sand it well, apply a coat of varnish, and then wax it. The base is a $\frac{3}{4}$ " by $3\frac{3}{4}$ " by $6\frac{1}{2}$ " block with a $\frac{1}{4}$ " bevel around the four top edges. It is also sanded smooth, varnished, and then waxed. Mount both the pig and trough with small flathead wood screws run up through the base and countersunk.—ELMA WALTNER.



Hollow Punch Cuts Stencils Lettered on Cardboard

WHEN a name or other lettering must be repeated a number of times on boxes, signs, and the like, a stencil can be cut quickly in cardboard with a hollow punch. Letter the name in with a pencil to guide the punch and lay the cardboard on several thicknesses of newspaper. The cardboard should be heavy enough to stand up under use, but not so thick that brushed or sprayed paint won't penetrate evenly.—BERNARD MATZEN.

Pocket Clip Fits Flat Pencil

CLIPS for flat carpenter's pencils can be cut with tin shears from hollow curtain rods of the kind shown beside the pencil in the photo. The clip part is bent to shape in a vise or with pliers, and burrs that may be left by the shears are smoothed off with a small file—RONALD EYRICH.

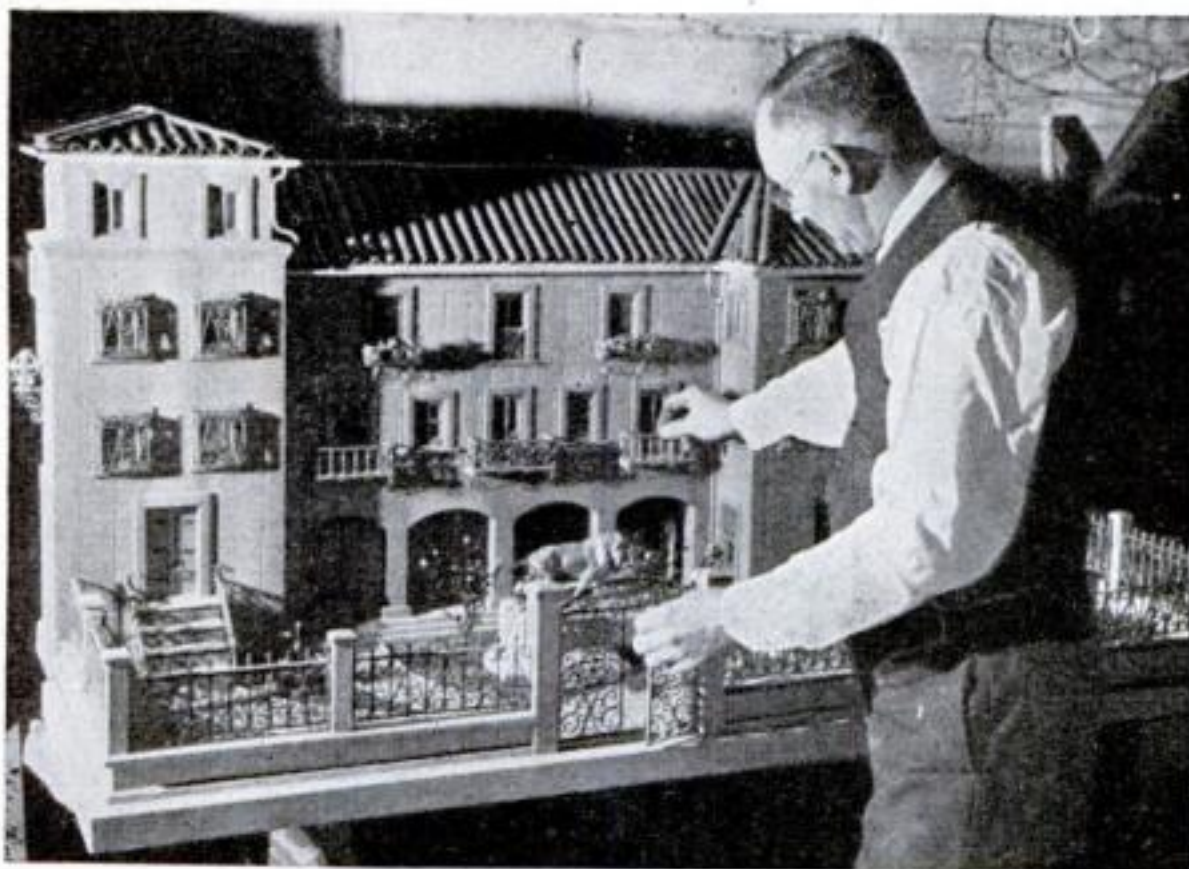


NOT content with fashioning intricate models of ships, buildings, and the like, Segundo Garcia, of New Brunswick, N. J., surrounds each with a lifelike scene in which all items are formed to scale. For example, his model of the Morro Castle, which burned off the New Jersey coast, has passengers in lifeboats and others in the water awaiting rescue. A 5½' model of the Manhattan is docked beside a pier covered with stevedores, loading vans, and stacked cargo for local color.

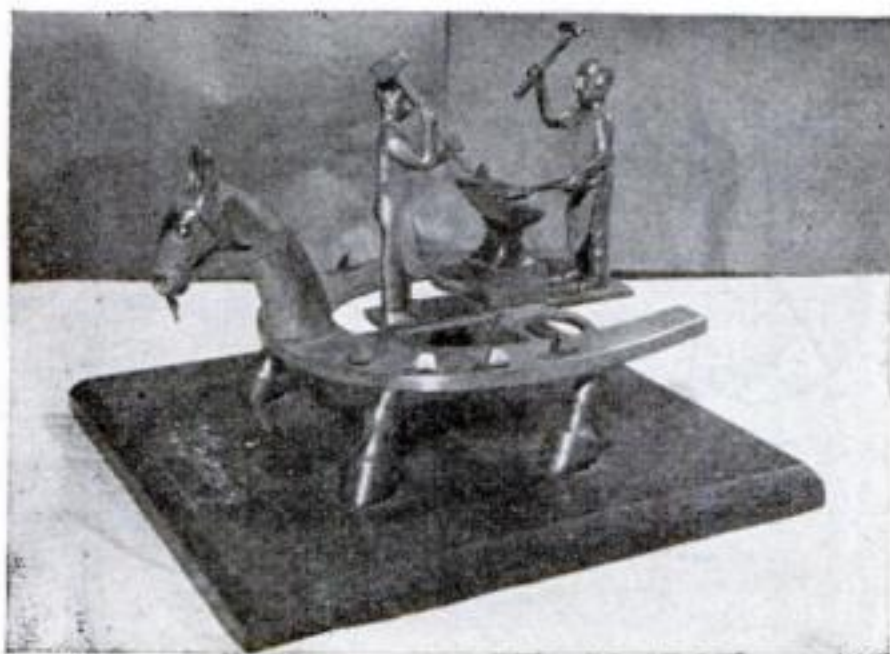


In this fully equipped cellar workshop, Segundo Garcia, a machinist by trade, finds a satisfying outlet for his creative ability by producing models of many kinds. Visible here are some of the ships he has built.

Maestro of Modelmaking



Made of wood to resemble stone, this Spanish mansion was one of Garcia's most ambitious pieces. It is 5' long and 39" high. A stainless steel gate swings on tiny hinges, the railings are of brass, and corrugated metal was painted so it would look like a tile roof. Note the small tree and carved figure in the patio.



Shaped by hand from stainless steel, the symbolic blacksmith group at left took two months to make. Its detail reflects the artist's touch inherent in all Garcia projects.

Carefully fashioned from mahogany, this 18" hull eventually will become a trim square-rigger. Like the others, it is built to scale.



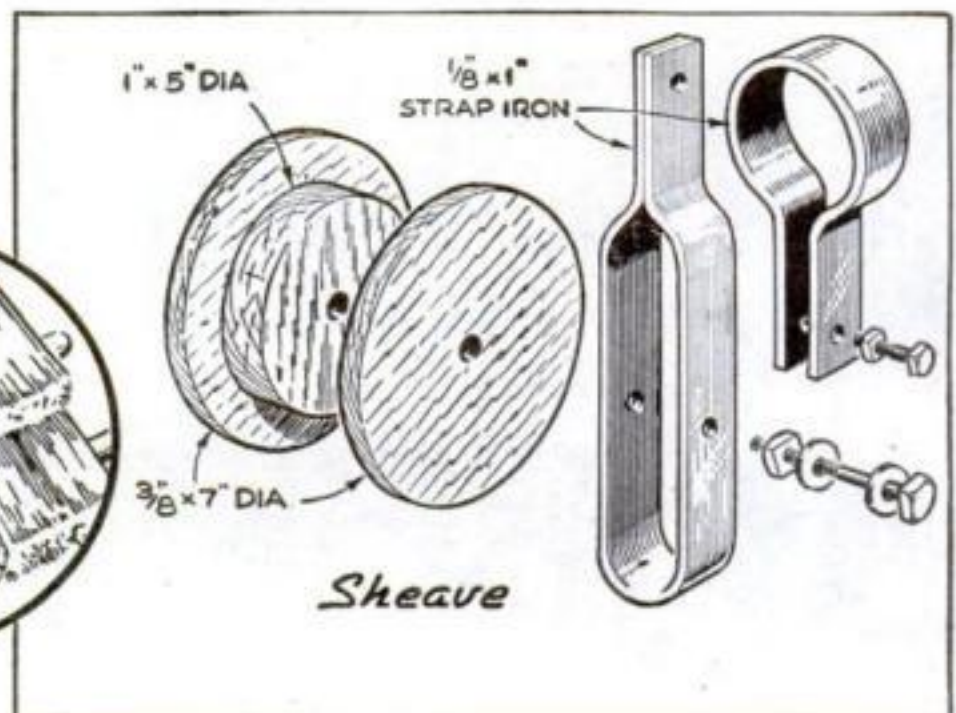
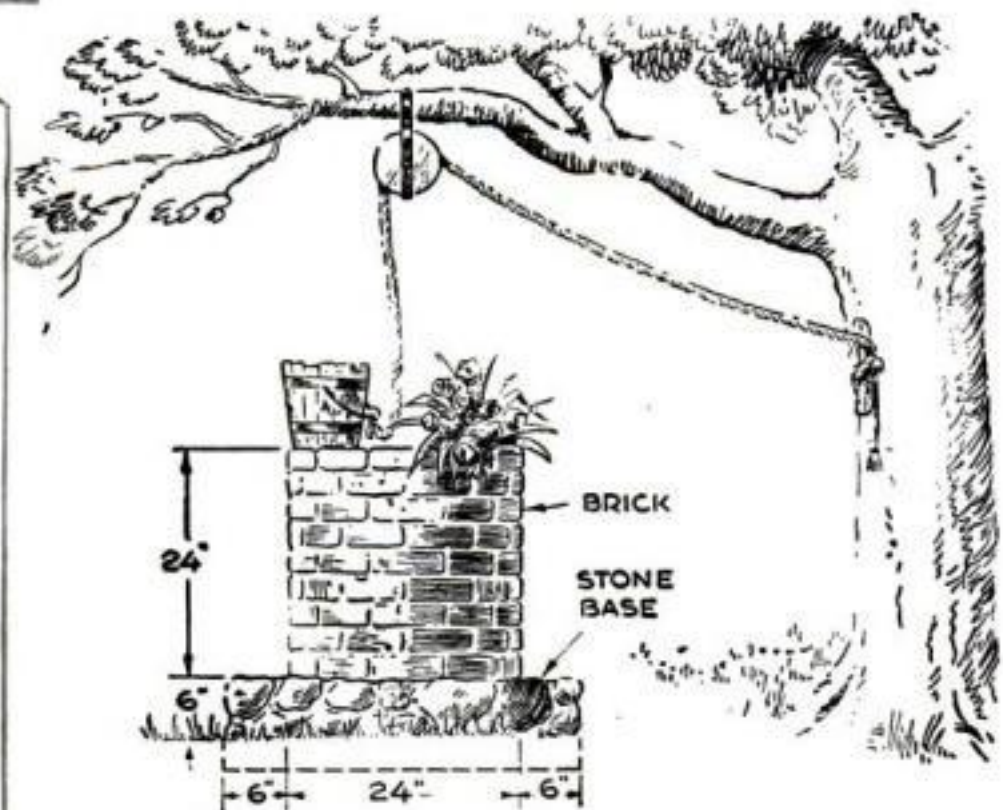
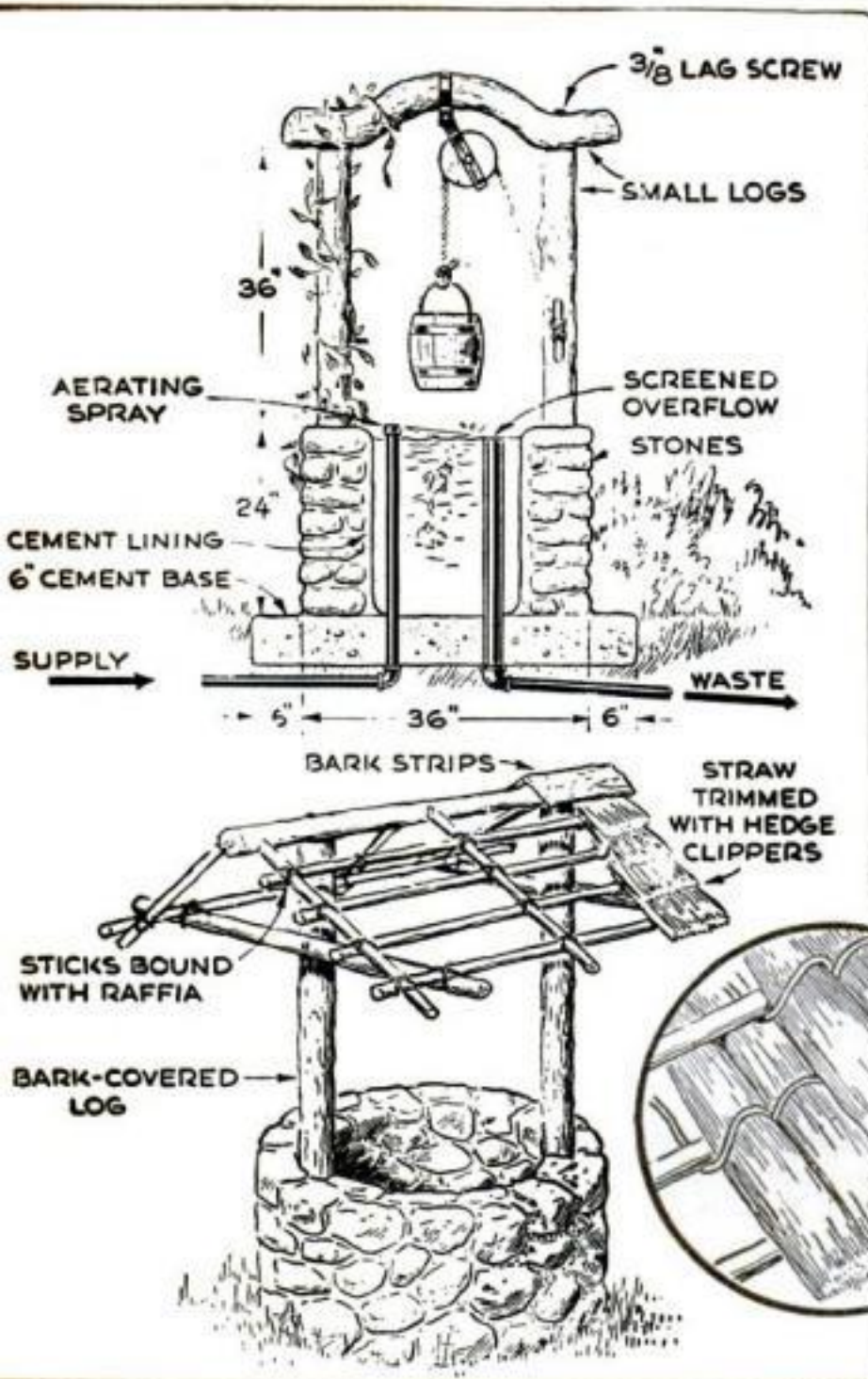


If You've Been

**A DUMMY WELL IS A DECORATIVE
FOCUS OF INTEREST IN A GARDEN**

WELLS like these never run dry—they are dry at the start, being intended solely for their ornamental value as a focal point in a garden. If you are so fortunate, however, as to own a real well, there is no reason why you cannot build a rustic stone wall around it to increase its beauty. Or, in the case of an artificial well, you can pipe it for a water supply and drain, cement the inside to make it water-tight, and have it serve as a fish or lily pond.

Stones and timber for a wall and superstructure can often be gathered in near-by fields and woods; old bricks may be collected, if preferred; and scrap strap iron, if needed, and a suitable pulley may be found in a junk pile. A



Wishing for a Well...

wooden pulley may be built as shown in a drawing. Some sand and cement will also be required for mortar.

Several designs for rustic wells are shown in the photos and drawings. Start any of them with at least a 6" foundation, buried or exposed. Be sure to provide for drainage of any parts where growing plants are to be included.

Set the posts into the masonry of the sides, and they'll stay tight for a long time. Tree limbs, given several coats of varnish to help keep the bark on, add a rustic note. A thatched roof of raffia-tied branches may be added. Tie on large handfuls of straw with raffia, as shown in a drawing, and trim with hedge clippers when the straw is in place.

Hardware stores carry suitable wooden buckets, or a paint or wine keg can be fitted with a bail to serve.—HI SIBLEY.

Arched gracefully above a well built of cut stone, a strap-iron support holds a pulley and old bucket.



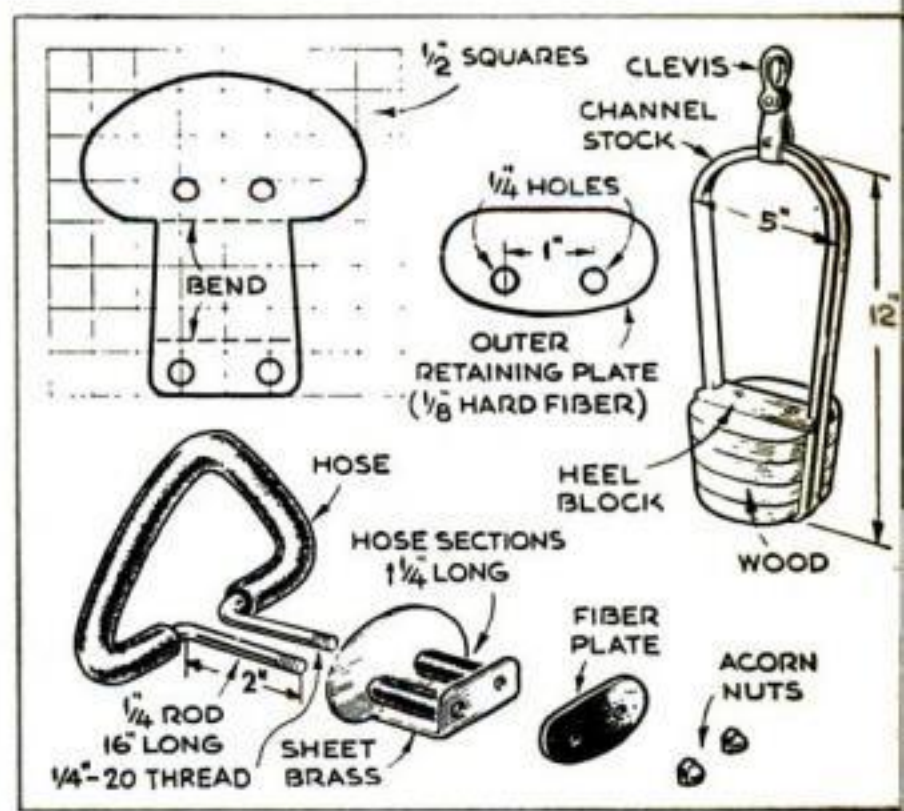
Pair of Stirrups and Hooks on Ropes Is Tree-Climbing Aid



Above, raising one rope. A strap encircling both tree and body would add security.

ANY tree can be climbed, or even a smooth steel pole, with a rig like this. A stirrup and a hooklike clamp fitting joined with strong rope make one of a pair. Reach high, circle the tree with one rope, run it over the clamp, and put one foot in the stirrup. Your weight will anchor the device on the tree. Then reach up, attach the other rope, and step into its stirrup. Raise the first rope, which should be longer than the other, and repeat.

Put the long piece of hose on the $\frac{1}{4}$ " rod before bending to shape and threading. Avoid nicks that may weaken the rod. The short hose sections should turn freely.—THOMAS MITCHELL.

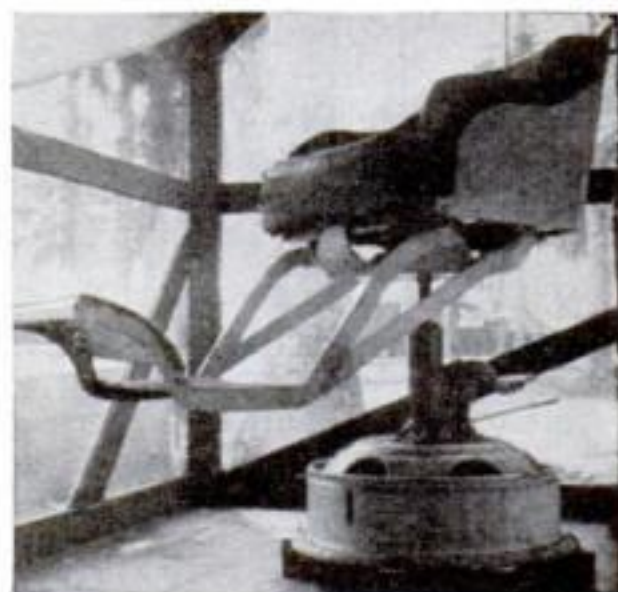


—YANKEE INGENUITY IN UNIFORM—



AMERICAN SOLDIERS, always resourceful, are solving problems all over the world with the means at hand. Here, Sgt. Carl M. Perin (left), of Newport, Ohio, sheet-metal specialist at a base in Britain, and Sgt. Erwin J. Schwade, of Fort Atkinson, Iowa, use a compressed-air tank that Perin made from an oxygen container. A sheet-metal rack, fitted with pressure gauge and carrying handle, encloses the tank, which is light enough to move easily from job to job.

HAIRCUTS are given on Guadalcanal in a barber chair that has most of the comforts of home. It was built by men of the 282nd Ordnance Company from a discarded truck wheel, a hydraulic jack, a jeep seat, and other junked material. The jack handle was replaced with a foot pedal.



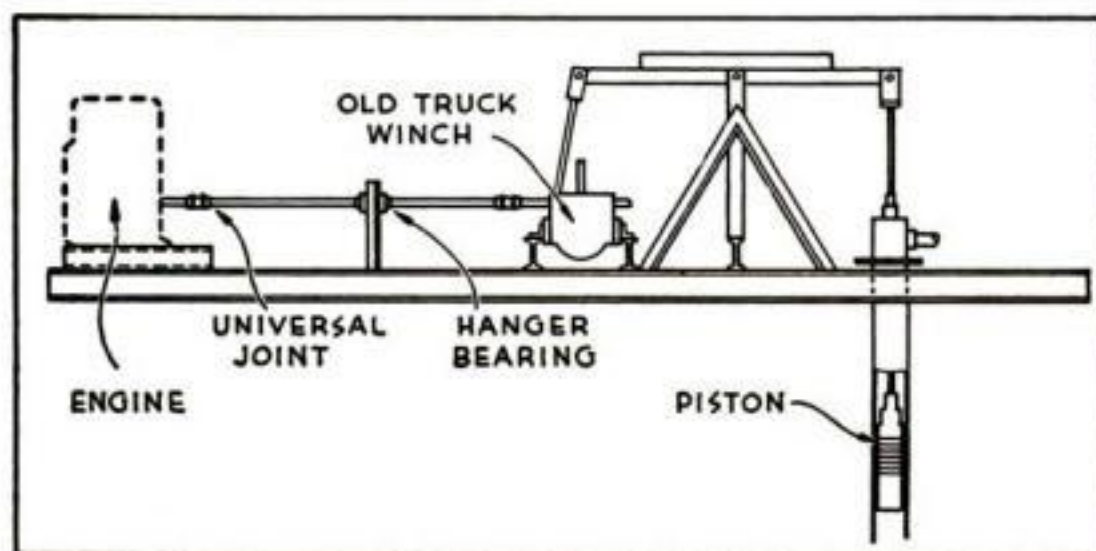
CORRODED SPARK PLUGS that were jammed tightly into their cylinder heads presented a problem to Master Sgt. Fred Covert, of Corsicana, Tex.—but not for long. Resorting to the technical know-how that men of the United States armed forces take along with them wherever they go, he soon evolved a procedure for extracting the plugs. He first rounded up several fire extinguishers at the Air Service Command Depot where he is stationed in England. Then he concentrated their blasts on a small surface, collecting enough carbon dioxide to form crystals of dry ice. Packing the crystals around the jammed plugs, he found that they soon contracted enough to be unscrewed.



ALL THE PURE WATER needed at a Pacific base, which originally had to rely on a supply distilled from the sea, now is furnished by a pump built of odds and ends. Power is supplied by an air-cooled gasoline engine. A truck winch provided the worm gear that

reduces shaft speed from 1,500 to 60 r.p.m. The reciprocating action required to operate the 55' suction rod is transmitted by means of a crank, two pitmans, and a walking beam. The long rod was pieced together from sections of concrete-reinforcing rods. All parts of the piston assembly were machined from scrap metal. Leather suction cups were tooled from a rifle boot.

Marine Gunnery Sgt. Elmer C. Wickstrom, of St. Paul, Minn., and the pump he devised to supply water at a Pacific base.



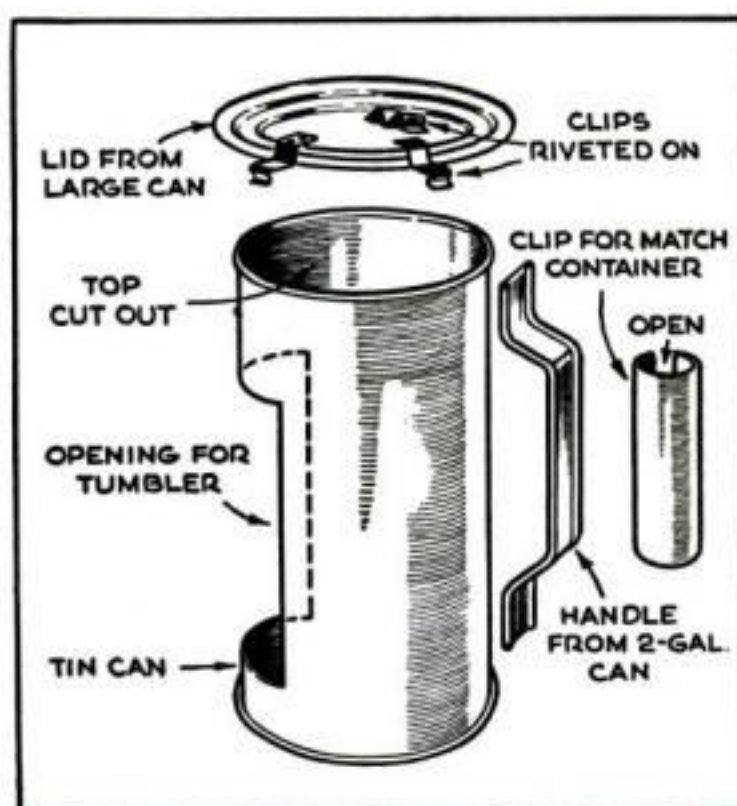


Candle Lantern Made from Tin Can Is Useful Indoors and Out

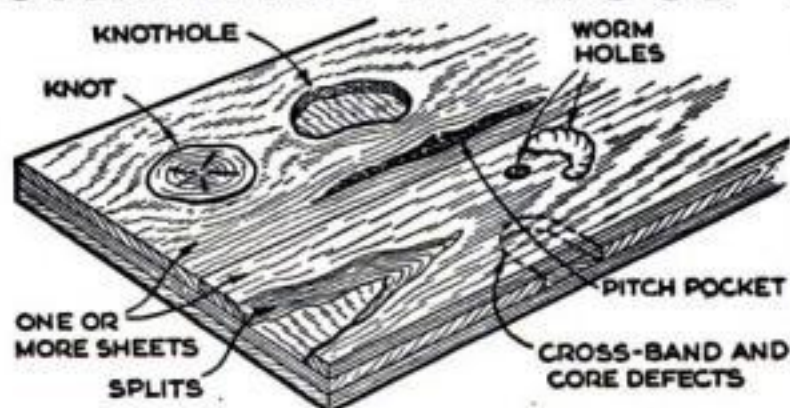
THIS lantern has a rather old-fashioned look, but you will find it handy in an emergency if you happen to be out of flashlight batteries. Remove the top from a tin can of suitable size with a rotary opener that leaves a smooth edge, and cut a rectangular opening in one side. The candle is held in a heavy tumbler. Spike it on a nail driven through the lid of a smaller can and set it in the bottom of the tumbler. The glass and a second lid, taken from a large can and provided with clips, protect the candle flame from wind.

A handle is soldered to the back of the lantern, and a rolled piece of tin-can stock is soldered on one edge to the handle. This forms a spring clip that will hold a beef-cube can in which matches may be kept.

The outside of the lantern may be finished, but leave the inside bright for a reflector.—R. S.



STANDARD PLYWOOD GRADES [WOODWORKING]



BACK OF WALLBOARD OR SHEATHING

10 KNOTHOLES ALLOWED;
1 1/2" MAXIMUM DIAMETER;
ONLY 5 EXCEEDING 3/4" IN
LARGEST DIAMETER



Grade	Abbr.	Face	Back	Surface
Plypanel	Good 2 sides	G2S	Good	Sanded
	Good 1 side	G1S	Sound	"
	Sound 2 sides	So2S	Sound	"
	Sound 1 side	So1S	Utility 1	"
Plywall	Wallboard 2	WB	"	"
Plyscord	Sheathing	SH	Utility 3	Unsanded
Plyform	Concrete form		Sound 4	Sound

1 Knots or holes in back 1" or less long way.

2 Made only in moisture-resistant grade.

3 Large knotholes and other defects patched in one side. Scored with lines 16" apart for guidance in nailing to studs and joists.

4 Outer plies, except in 1/4" plywood, 1/8" thick before sanding. No knotholes in cross-banding. Waterproof bonding, surface mill-oiled, edges sealed with special green paint.

The permissible defects are illustrated in the drawings at left which show the back of wallboard and sheathing and the face of moisture-resistant sheathing.

Specifications are those of the Douglas Fir Plywood Association. The same gradings apply in general to moisture-resistant and exterior plywood, but exterior allows neither gaps nor core voids that impair the serviceability of a panel.

POPULAR SCIENCE MONTHLY SHOP DATA



Small tools are essential equipment in the workshop of modelmaker Joseph McCord, shown at right using a watchmaker's lathe to turn a table leg. At left, a nail too tiny for the fingers is held with tweezers.

It's the Little Things That Count

MODELMAKING led to a big event in the lives of Mr. and Mrs. Joseph McCord—their marriage. They met at the New York World's Fair, where between them they had built or were in charge of more than 40 miniature exhibits. Little things still are big business with them, and the second floor of their Greenwich Village home is lined with shelves filled with a variety of tiny objects they have made.

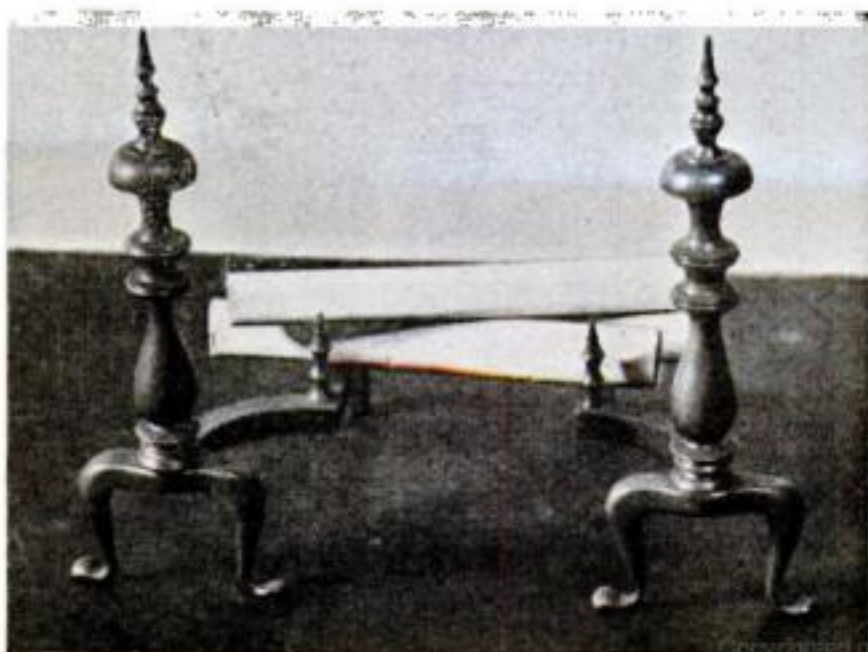
Like many other modelmakers, the McCords always are on the lookout for small tools to add to their collection. They use surgical, dental, and watchmaking tools, altering them, if necessary, to suit the requirements of a particular job. Frequently they design and make their own. Extremely fine work is done under a magnifying glass.

Mr. and Mrs. McCord specialize in furniture, but they also have built automobiles, boats, aircraft, and other items—all work-

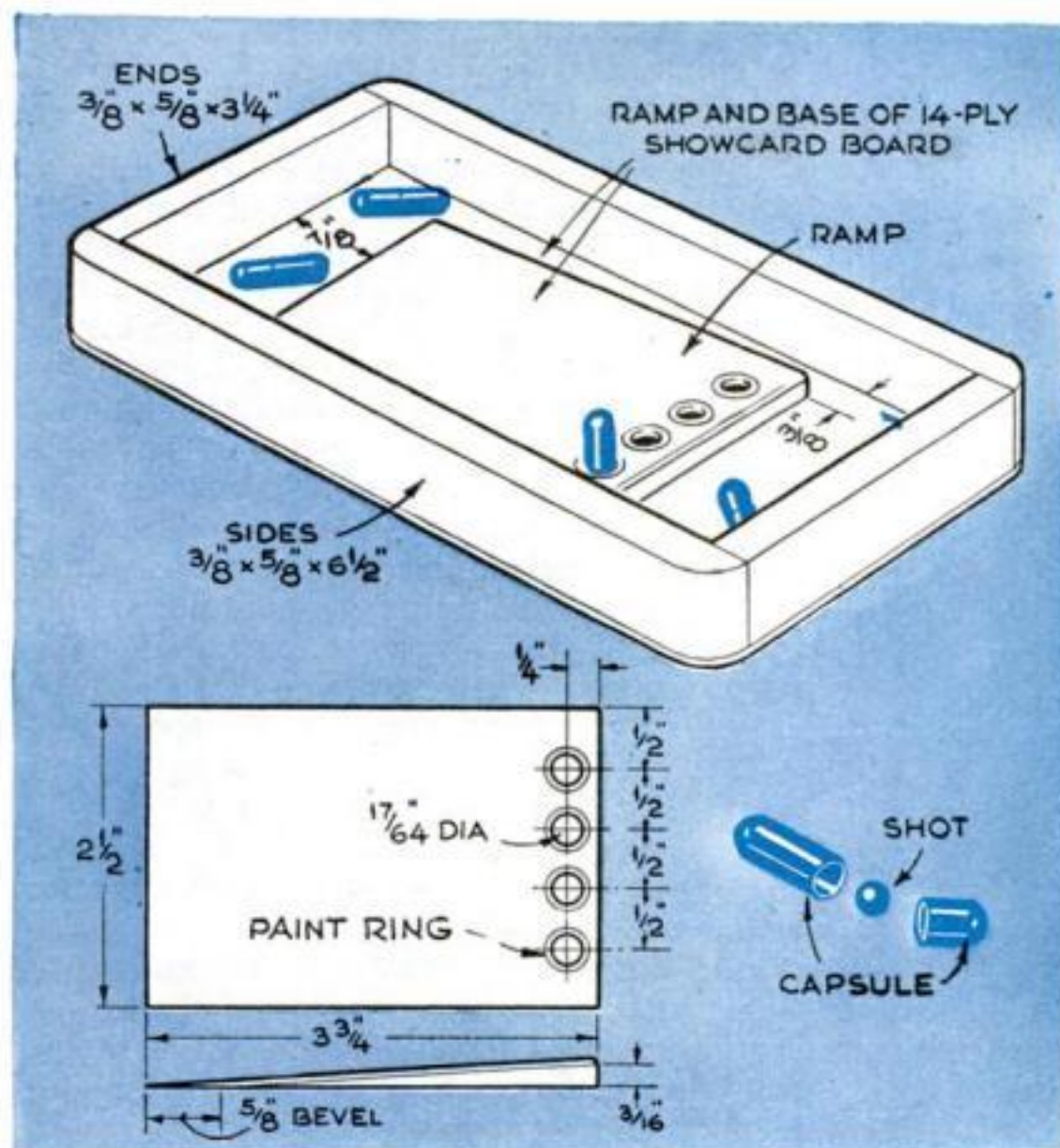
able and formed to scale. Furniture manufacturers often study their models to determine the feasibility of putting full-sized pieces into production, and collectors willingly pay high prices for the items.



Just the right size for a Lilliputian family, the furniture and pair of miniature brass andirons below represent many hours of patient work, each piece being formed to exact scale. Cigarettes serve as logs on the andirons. A collector paid \$65 for the pair. Note the 6" rule in the center of the tools above.



Pocket-Size Game Is Played with Lively Bobbing Capsules



the starting point for another try, and some already in holes may fall out and have to be maneuvered in again.

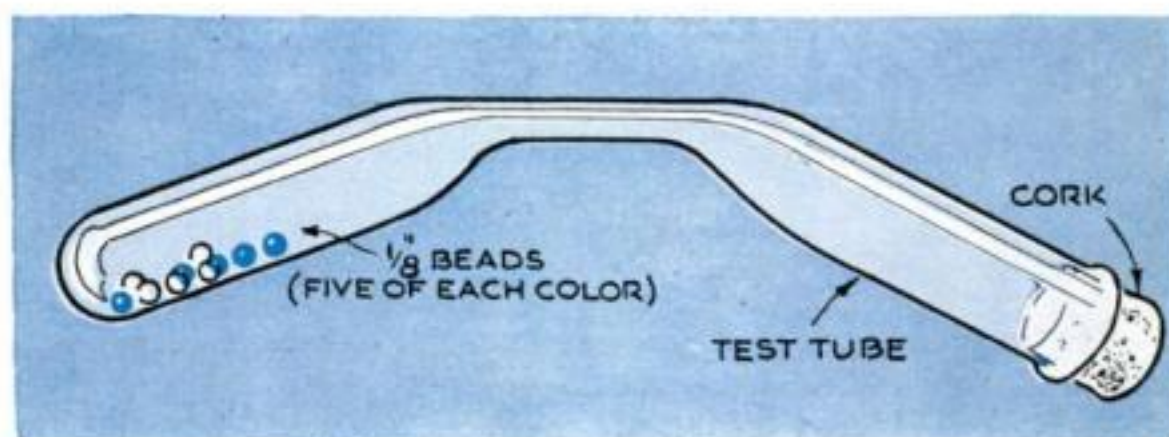
Each player keeps the board until all the capsules are in

PLAYED with four capsules, each containing a lead shot, this game will send you into tailspins of excitement and exasperation. The object is to roll the capsules up the ramp and into the holes. But there's a catch. Those that fail to stop in holes must be returned along the side of the ramp to

holes. Scoring may be by time or by the number of trips capsules make up the ramp.

You can make the game harder by lacquering half of each capsule one color and half another, and then requiring them to land in holes with the same color up. Drug-gists can supply capsules—FRANK SHORE.

Colored Beads in Test Tube Separate at "Bridge of Sighs"



MAKING this game requires little skill in glass bending; playing it requires quite a bit more of another kind. Heat a test tube at the center by rotating it in the flame of a Bunsen burner, and remove it when the flame becomes yellow. Then pull the ends to stretch the center while the tube is hot and bend the ends down slightly.

Put five $\frac{1}{8}$ " beads of one color and five of another in the tube and cork it. The object is to separate the colors on either side of the "bridge."—GEORGE BARR.



By EDWIN M. LOVE

LOW-RELIEF, or bas-relief, ornamentation was often employed by early craftsmen who enriched the surfaces of chests with chisel-cut designs. It is the next step after chip and incised carving toward advanced wood carving.

As a variant, strapwork projects cover a wide field from simple layouts to intricate all-over patterns of interlacing bands, ribbons, and leaves. Low relief itself is espe-

Scoring across the grain assures clean edges when wood of alternate hard and soft grain is carved.



WOOD CARVING

Chisel and Strapwork Designs

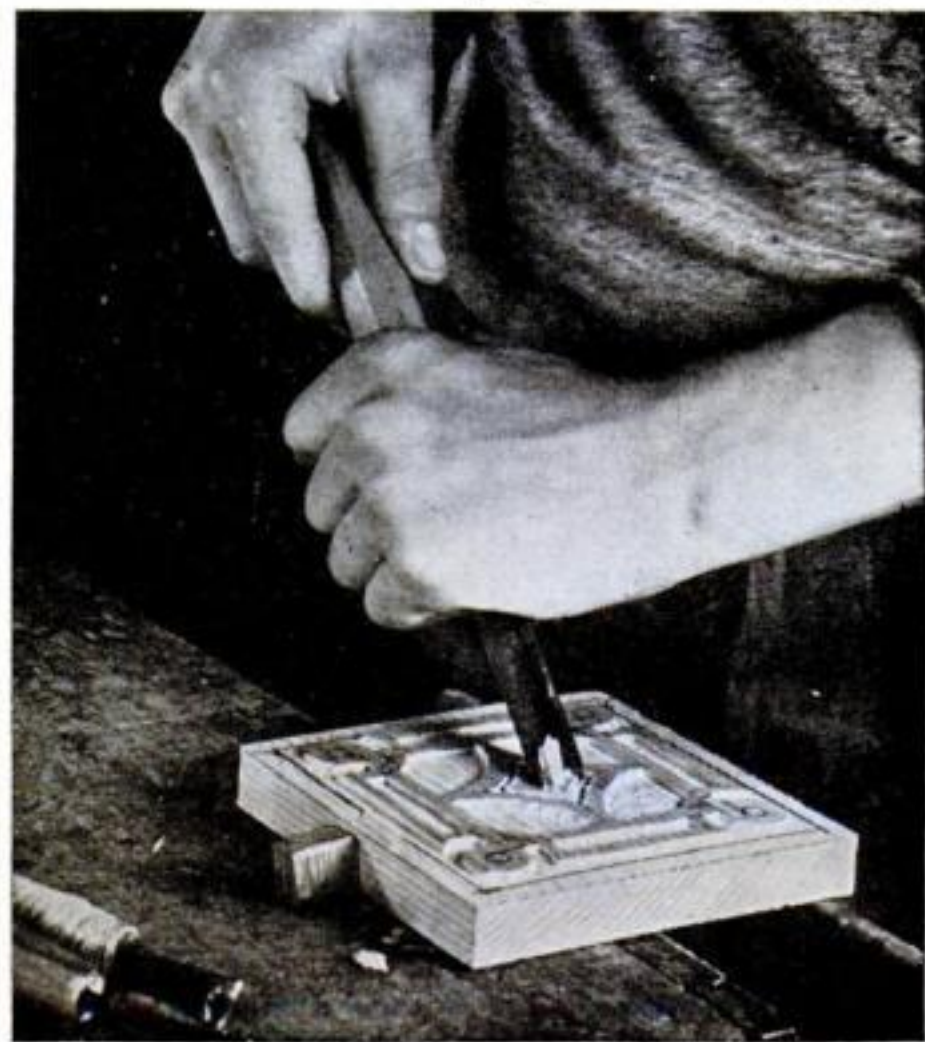
cially suited to decoration of the rails and stiles of a framed assembly, if the shallow grounding will not weaken joints, and the flatness of its ornament is a good foil for boldly modeled panels carved in high relief.

What tools are required? Avoid boxed sets and choose instead from the hundreds of chisels available. Wood can be carved with a very few chisels, if necessary. It is best to buy a few good ones and then add to your collection as experience demands. These 16 chisels and gouges should be ample for all but the most professional needs: skew knife; $\frac{1}{8}$ ", $\frac{5}{16}$ ", and $\frac{7}{16}$ " carving chisels; $\frac{1}{4}$ ", $\frac{3}{8}$ ", and $\frac{1}{2}$ " firmer chisels; $\frac{3}{32}$ ", $\frac{1}{8}$ ", $\frac{1}{4}$ ", $\frac{3}{8}$ " $\frac{7}{16}$ ", and $\frac{1}{2}$ " veining gouges; V-tool or veiner; and $\frac{3}{8}$ " left and right bent-back spoon skewers.

How is the carving done? Take the low-relief book ends shown at the top of the facing page as an example. Draw the design with a pencil and try square, and gauge a pencil line along the edge to limit the border depth. If the material is spongy, or soft and hard grain alternate, score the edge of the raised parts across the grain to sever the hard grain and to prevent tearing of the soft wood. Experimental cuts on waste wood are advisable.

Then, with a $\frac{1}{8}$ " veining gouge held with the handle low, follow the scored outlines,

Grounds are roughed with a large gouge and then smoothed with a flatter gouge or a flat chisel.



IN LOW RELIEF

Ornament Frames and Panels

rotating the blade slightly for a shearing cut. Trim the ends first, and then cut the edges, guiding the course of the gouge where the grain tends to lead it off the line.

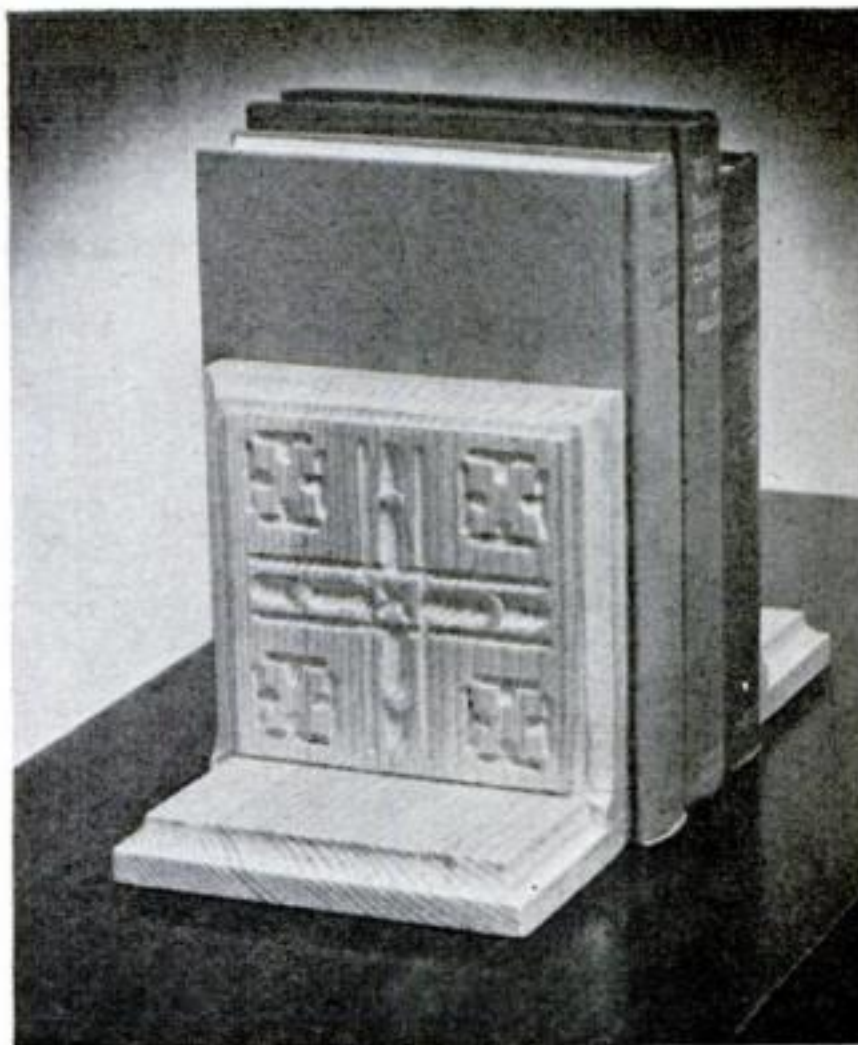
Cut the tops of the T's with the same tool, and then, making a stop cut at one end and working toward it from the other, cut the long slender center flutes that cross the grain. In spongy wood such as pine, take a roughing cut and follow with a trimming cut to depth. If the lengthwise flutes are made first, their edges will splinter when the cross flutes are cut through them.

Now work the short flutes of the legs of the T's with a $\frac{1}{4}$ " gouge, cutting from the round ends unless direction of grain prevents. Take the small gouge again and hollow the lengthwise flutes and center cross.

Are wide stopped flutes made the same way? Make stop cuts at the inner ends of the outer flutes; then establish the lines with light cuts of the gouge held in a vertical position, and deepen the center with a roundnose gouge or narrow flat chisel. The square in the center stops the inner flutes, but a little trimming is needed because of the greater depth of the wide flutes.

How is the border lowered? Carve away the ground with a wide gouge pushed diagonally across the grain with sidewise-sliding strokes. True with a flatter gouge and

Straps appear to cross over others when they are beveled. Stop cuts are made along upper straps.



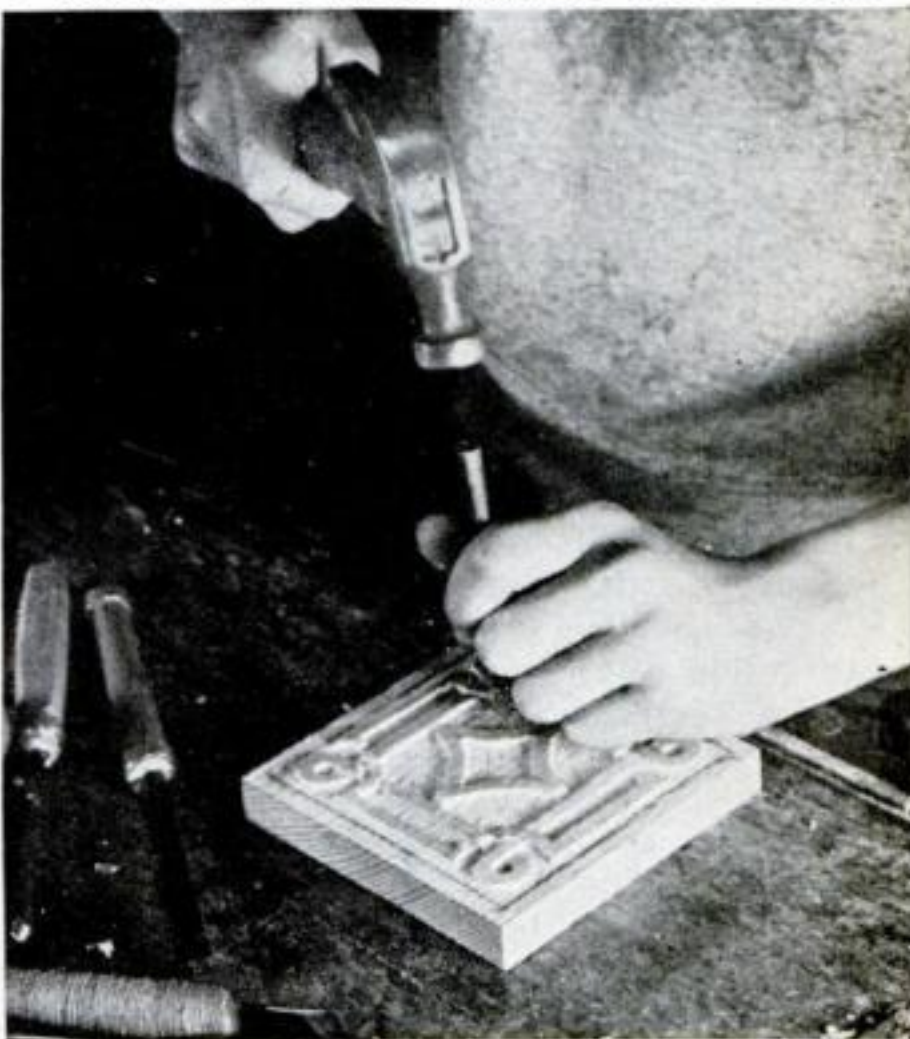
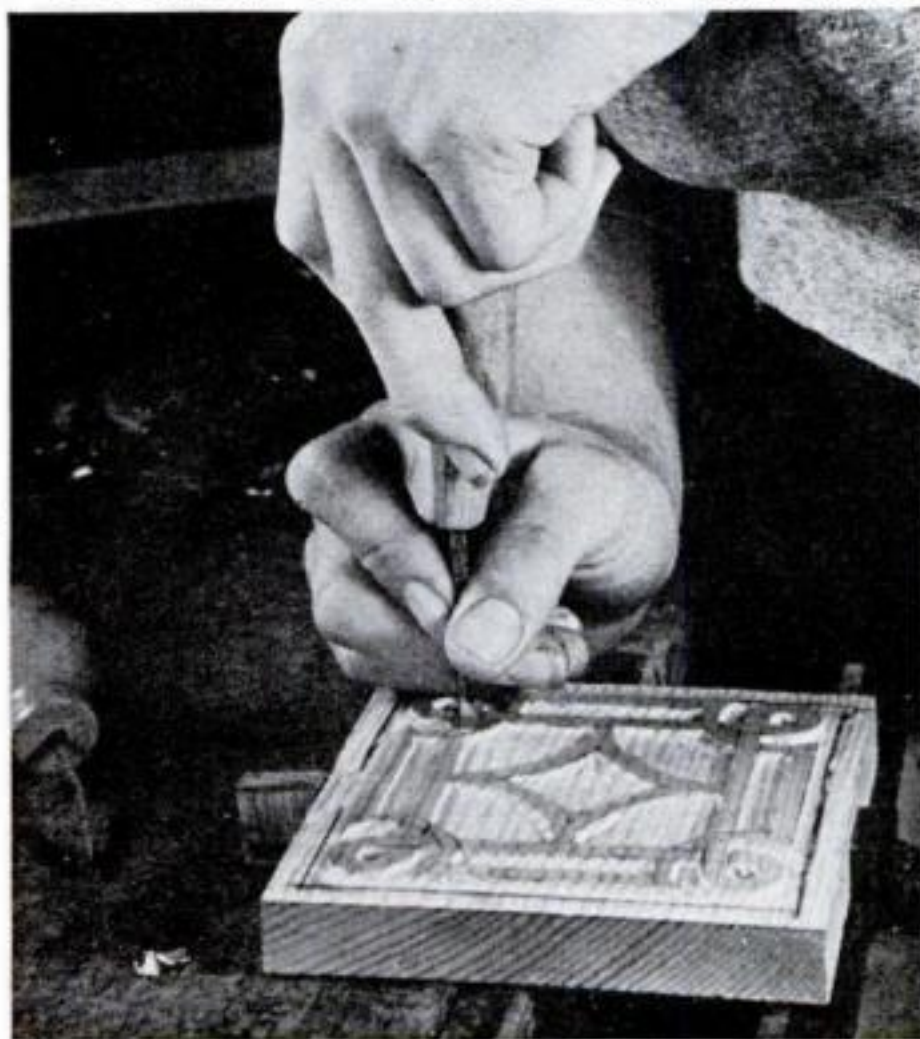
level with a flat chisel. If necessary, deepen the edge cut of the raised section with a veining gouge.

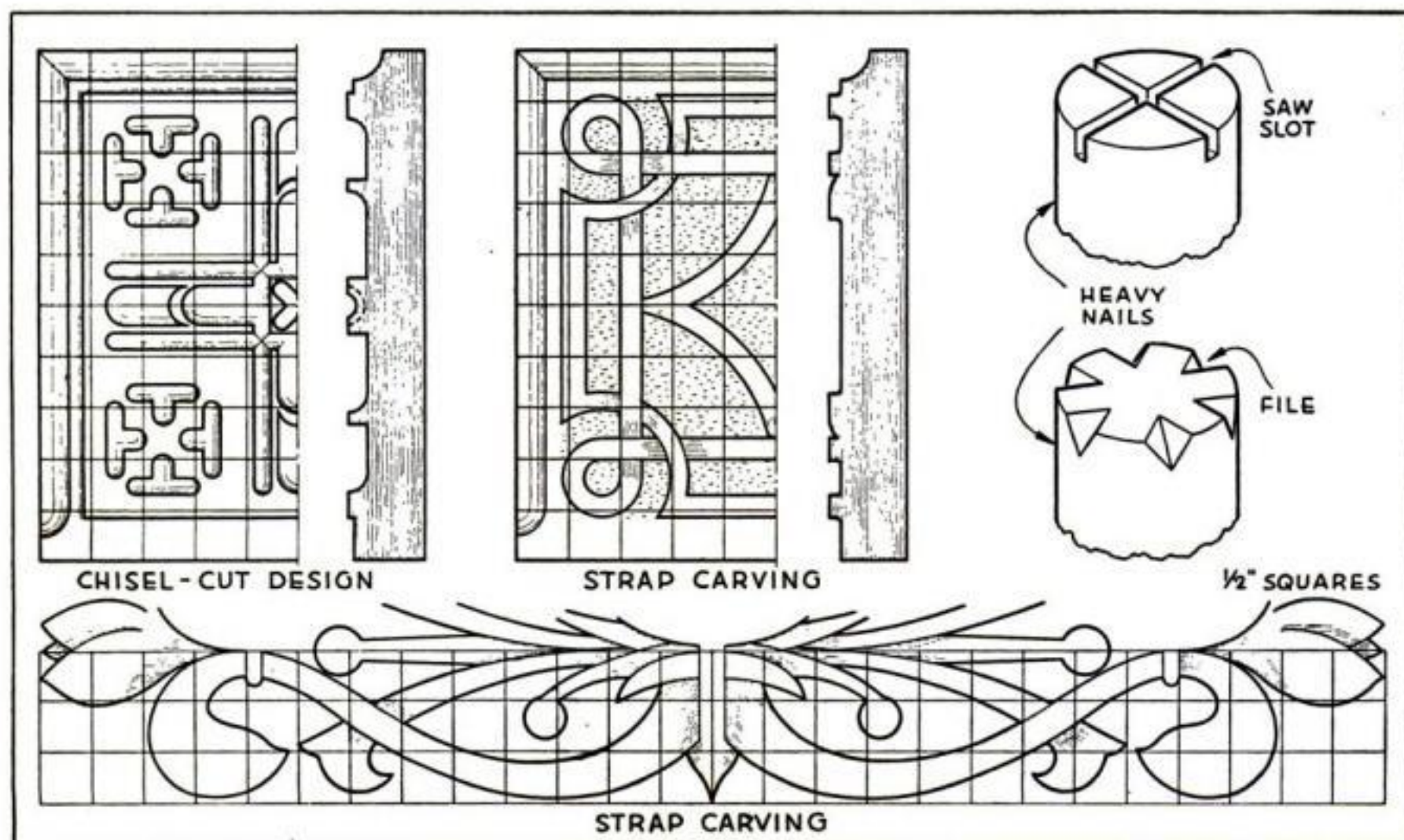
What is done for edge coves? Gauge guide lines on the face and edges, and chamfer with a flat chisel. Then gouge out the coves. Note the stops near the bottom edge.

Should pencil lines be sanded off? Use a pencil eraser. This keeps the edges sharp. Then sand, using a hard backing block.

Is the strapwork book end more difficult?

Grounds stippled with a stamp or punch are given a texture that contrasts with the raised design.





Only slightly. Lower the ground, as was done with the border of the other book end, or rout in a drill press to save time after outlining the straps with a veining gouge. The effect of one strap passing under another is obtained by beveling it smoothly down toward both edges of the upper strap. Make a stop cut on each side of the upper strap and trim the other with a flat chisel used with a shearing cut. If possible, carve with the grain across straps that run at right angles to the grain.

How is ground stippling done? Punches made like the two shown in the drawing are used. Ground stippling is a final leveling that gives a textured ground contrasting agreeably with the raised design.

Is floral strapwork different? The execution is much the same. A panel like that shown at the right is outlined with a veining gouge. Cuts are taken with the grain in one direction, and then the piece is reversed for cuts in the opposite direction. A V-veiner and narrow flat chisel are useful for trimming corner pockets.

Can strapwork treatment be varied? One side of the panel shown has been given a crossover treatment, while the other has been outlined with a V-tool. The piece can also be left as completed when the ground has been sunk. Such flatness gives the effect of a thin scroll-sawed piece glued to the ground, especially when the wood is without prominent grain. The ground can be left gouge-flat, it can be tex-



Grounds for strapwork are gouged or routed out. The straps are outlined first with a veining gouge, as in the photo above. Crossover straps are shown on one side of the panel below, outlined straps on the other.



tured with small gouge cuts, or it may be stamped with a punch.

Is color suitable for carvings? Painted grounds and varnished patterns are effective, or polychrome treatment is good if the colors selected are harmonious and subdued.

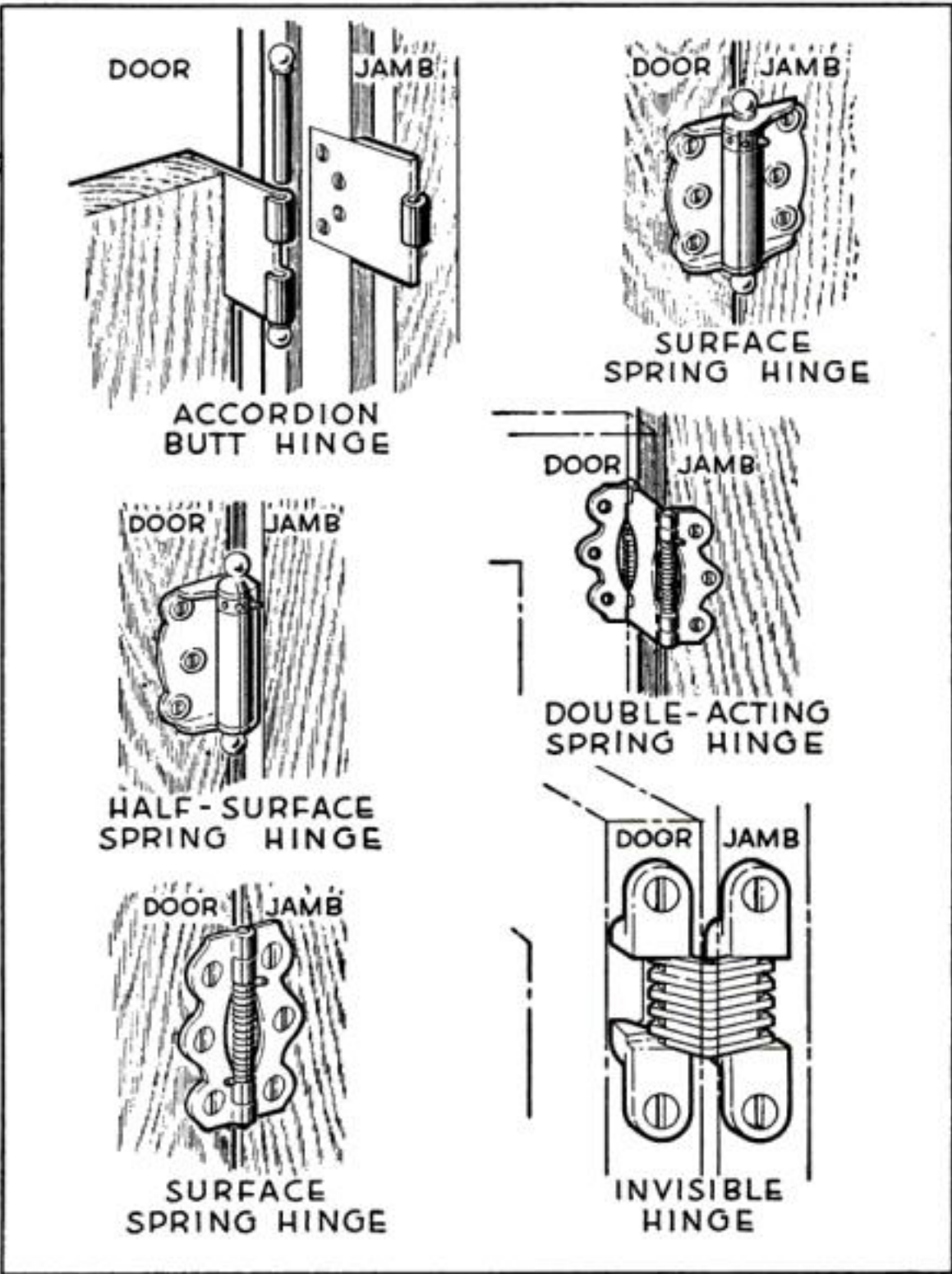
DOOR HINGES FOR SPECIAL PURPOSES

HINGES are made in many styles other than the strap and butt familiar in all home workshops. When glass doors are to be fitted with drapes, for instance, accordion butts are used. These have wide leaves that set the pivots well out and hold open doors away from the casings to leave clearance for curtain rods. Similar hinges, called parliament butts, are used on casements swinging inside.

Invisible hinges have a series of folding leaves and lugs set into mortises. They are hidden when the door is closed.

Surface spring hinges serve on flush screen doors. Some have holes into which a pin can be shifted to adjust tension. Those without adjustment are likely to let a door stand open a little after the springs weaken with wear. When a door is hung on a jamb having a projecting molding, as in a stucco wall, a half-surface hinge is required, one leaf on the door and the other mortised at 90 deg. in the jamb.

Double-acting hinges are for doors that swing both ways. The leaves go on opposite door and jamb faces.—E. M. L.

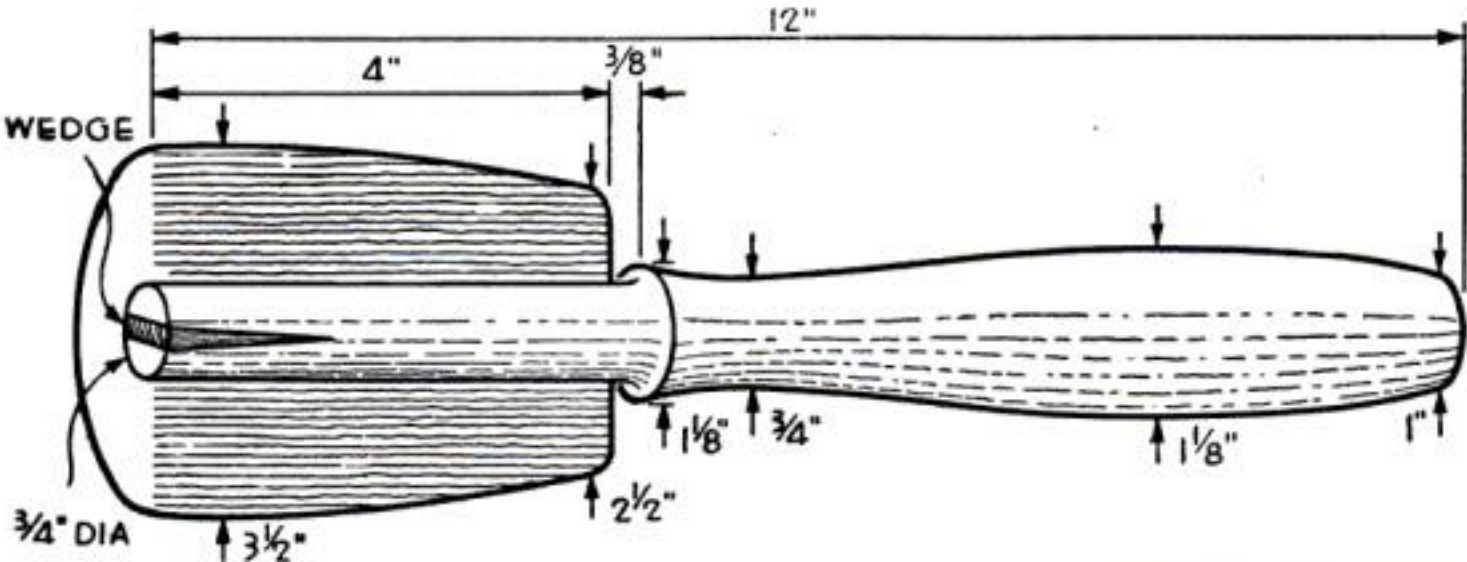


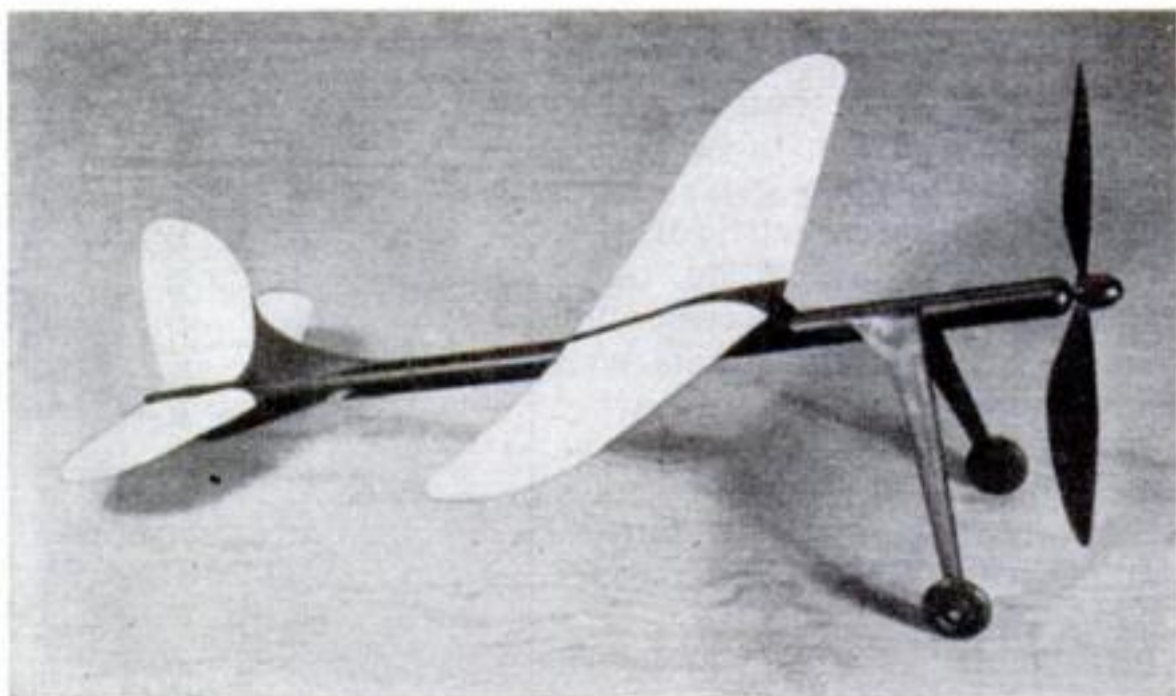
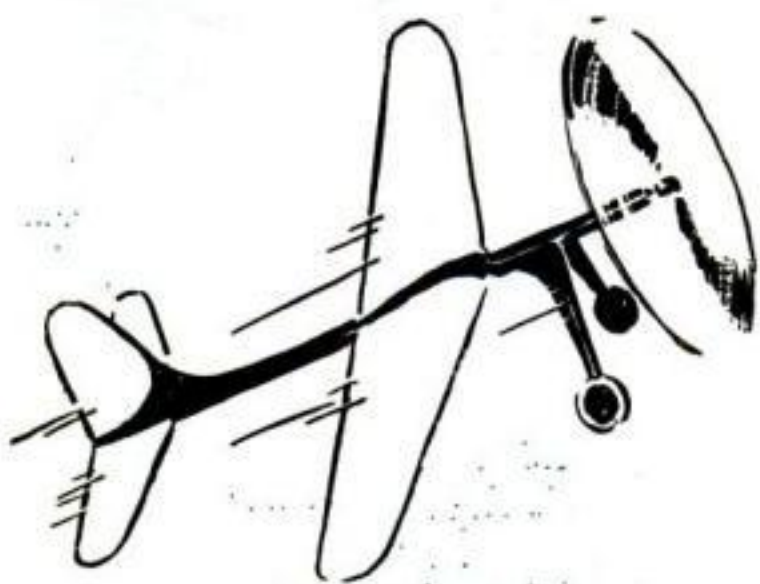
Efficient Wood-Carving Mallet Turned from Oak

ROUND mallets are particularly favored by wood carvers, for they can strike the chisel with any face. They should be turned from oak or other hardwood.

Taper and crown the head and round the corners. Bore the head from both

ends to assure centering. Turn the handle to a snug fit and saw a kerf $1\frac{1}{2}$ " deep in the end. Drive the handle in until it binds, drive a hardwood wedge into the kerf, and cut flush. Finish with a coat of shellac.—E. M. L.





By H. A. THOMAS, Jr.

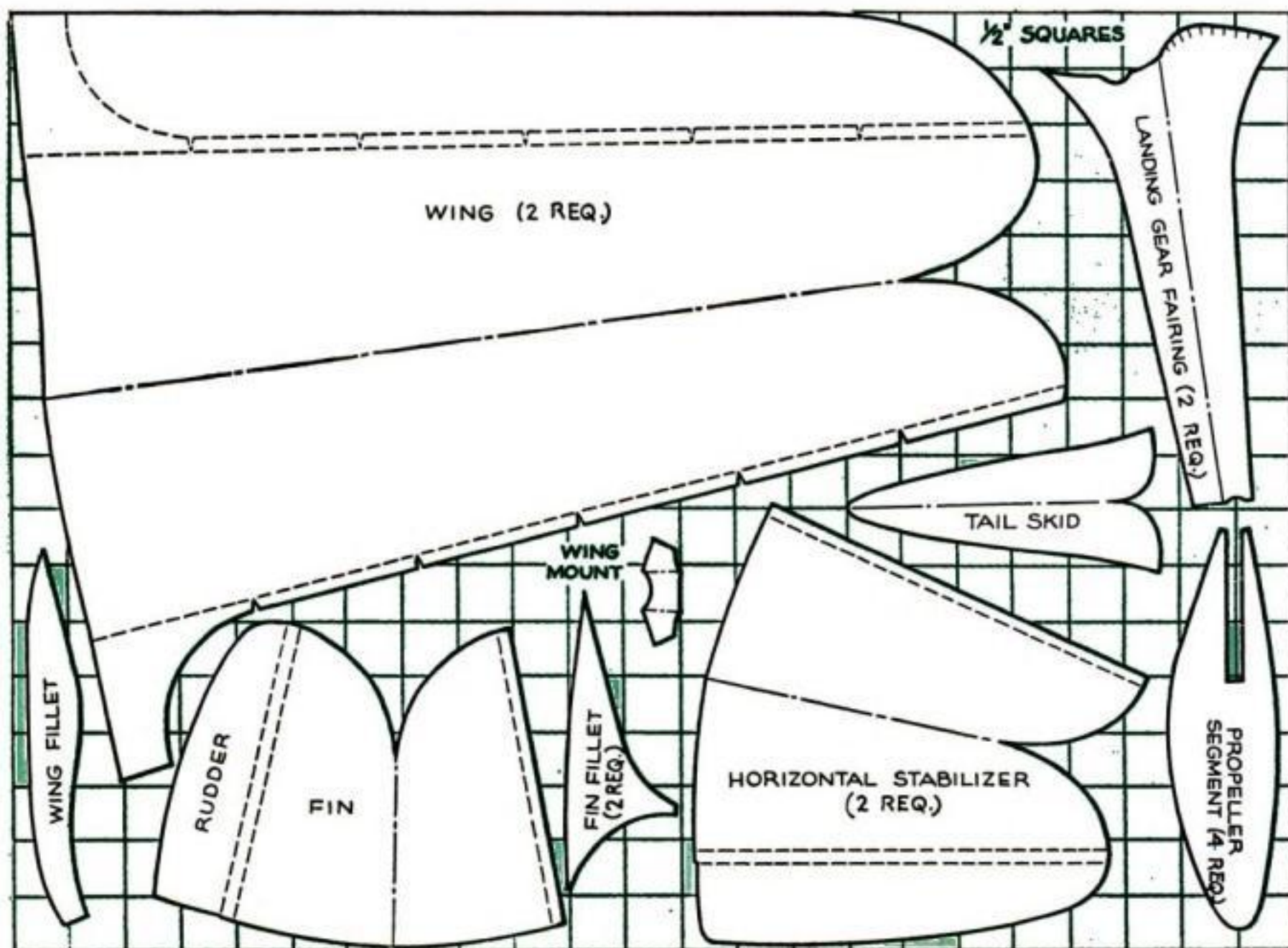
ONE of the bad things about a good thing is that it sometimes keeps us from looking for something better. Take model materials, for example. Balsa has long ruled the flying-model field because of its light weight and relative strength. So long as balsa was freely available, even its most vocal critics did very little in the way of investigating the properties and peculiarities of substitute materials.

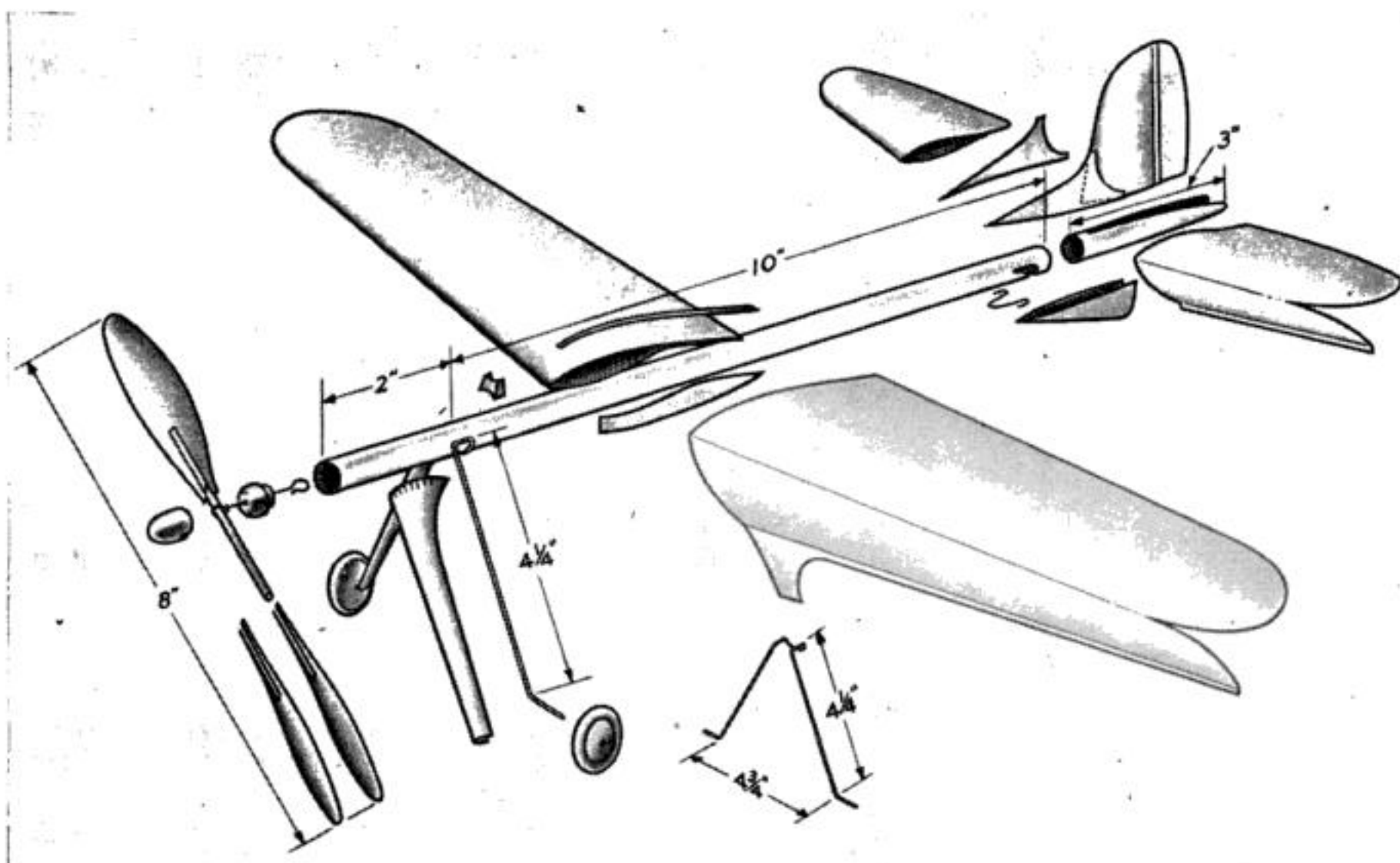
Then came the era of shortages and modelers were forced to look around. Using heavier materials, it was sometimes found necessary to add small paper parts here and

there as a way of minimizing weight. The successful use of paper on these wartime models brought attention to its surprising possibilities. It has limitations, of course, and these must be understood from the beginning.

Improperly used, paper is weak and flimsy, but if it is shaped into tubular, box, or channel form, it is quite strong enough for our purposes. The secret of a successful paper plane lies in the use of good-quality stock. Two-ply Bristol board meets most specifications. Several layers held together with library paste produce a tough sheet; model cement is used for seams and joints.

The 12" motor tube and 3" tail section of

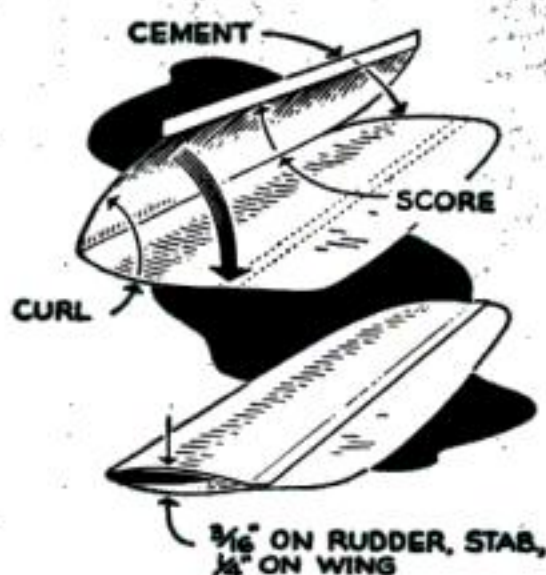




the fuselage of this paper model can be made separately or in a single operation. In the latter case you will need a 6" by 15" piece of drawing paper. Roll the sheet around a waxed $\frac{1}{2}$ " dowel, applying library paste liberally. When dry, the tube may be slipped off the dowel, lightly sanded, and doped. Cut it into one 12" and one 3" piece with a fine saw. With the same blade cut the opening for the rear hook and the long notches for tapering the rear section.

On a grid of $\frac{1}{2}$ " squares, lay out wing and tail-group parts. Curved surfaces can be curled by pulling them over a table edge. To get the clean bends needed at the leading edges, score the paper heavily with a sharp pencil on the inside of the bend. The dotted alleys on the drawings show where the cement is to be applied for joining the upper and lower edges. Severe warping may result from any misalignment of this seam.

Cut four propeller segments and join them in pairs with library paste. Before the paste sets, shape a $\frac{1}{8}$ " camber in each blade and form the twist which reduces the pitch of the blades toward the tips. A $\frac{1}{8}$ " by $3\frac{1}{2}$ " dowel is used to connect the two blades of the propeller. Bend the wire shaft around the dowel and attach a spinner made of balsa or other wood scrap. Next, cement



the blades to the dowel at an approximately 45-deg. angle. Finally, taper the dowel ends flush with the blade surfaces and sand and dope the unit several times. Carve the nose plug—also made of wood—to a tight fit in the motor tube. Attach the propeller and install a four-strand rubber-band motor.

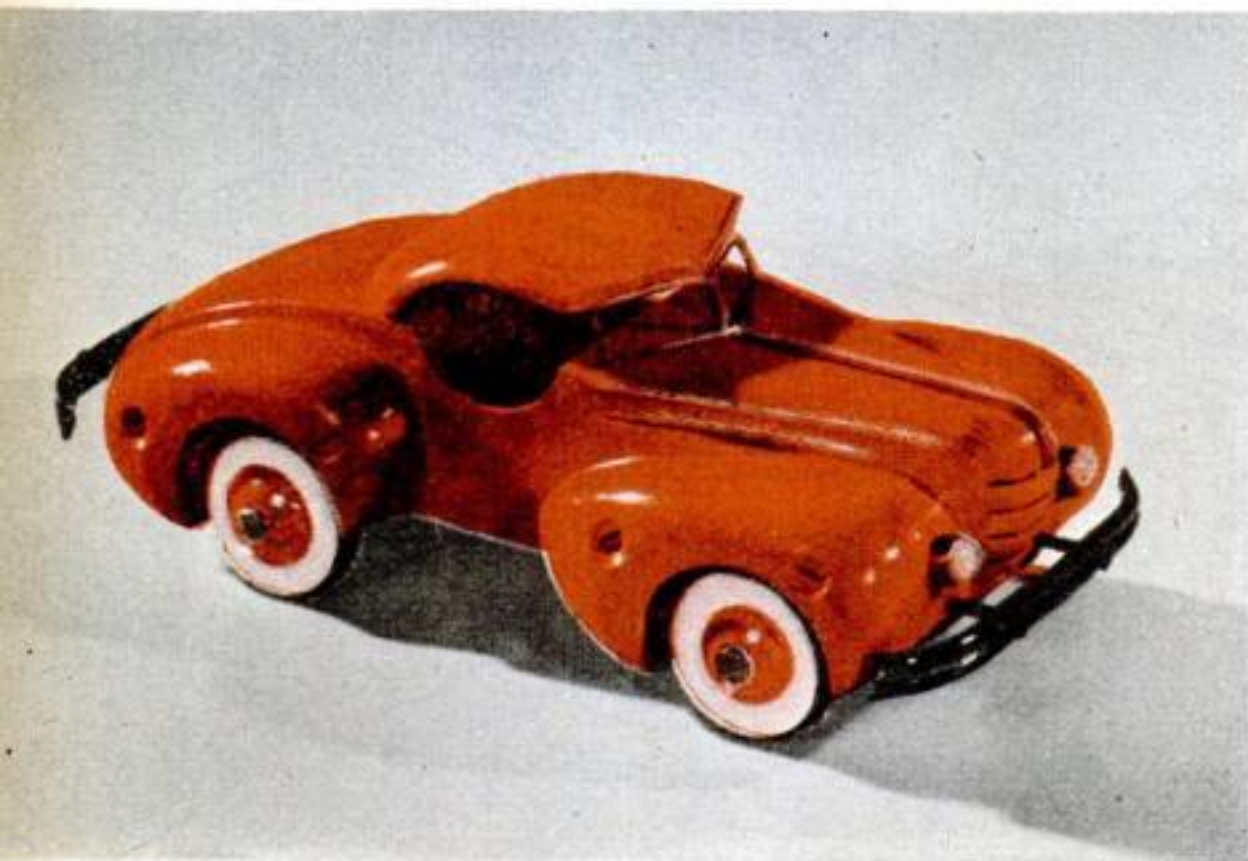
Assemble the parts as indicated in the pull-apart drawing above, using cement sparingly. The wire

landing gear should be cemented in place and fitted with paper fairings. Pin the wings on to test the balance, then butt-join and cement them to the fuselage by means of the wing mount and the two wing fillets. Be sure to have the wing tips $1\frac{1}{4}$ " higher than the roots to insure enough dihedral angle.

Fairings, motor tube, and propeller may be finished with colored dope, but the other parts had best be left alone because paint or dope may warp the paper. When the wing tips are lightly balanced between the fingers, the plane should hang level. If it doesn't, add a bit of modeling clay to the lighter end. Minor adjustments can also be made by bending the trailing edges of the rudder, stabilizers, and wings.

Fly this model as you would any other. If you don't try to use it in damp weather, you should find it a durable, capable flyer.

TOY ROADSTER BUILT FROM WOOD



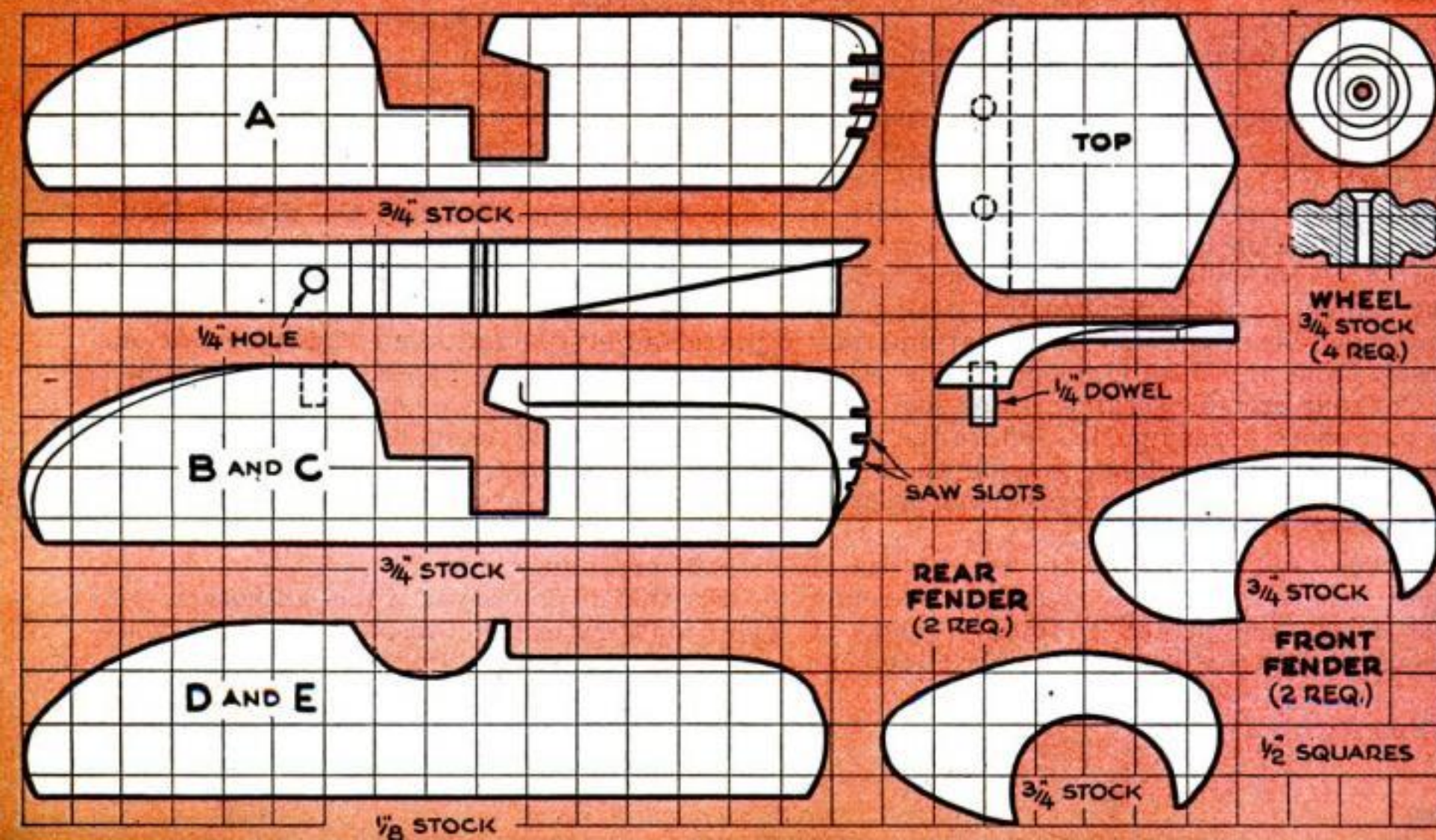
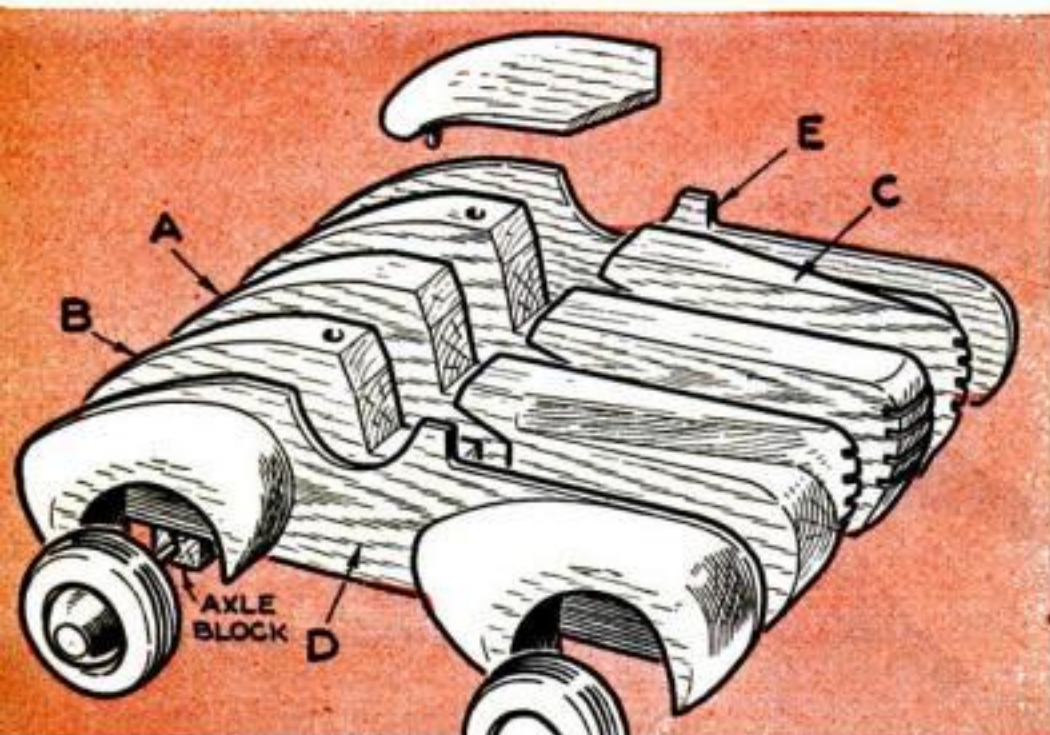
THREE blocks of $\frac{3}{4}$ " white pine or other soft wood and two of $\frac{1}{8}$ " stock make the body of this toy automobile. Lay out the profiles carefully and saw the blocks to shape on a band-saw or jigsaw. Make a trial assembly of the $\frac{3}{4}$ " blocks, holding them with light nails, and file the seat slots if necessary to align them. The kerfs representing the radiator grille can be sawed during this assembly, but save tapering of the hood until the fenders have been put on. This can be done by hand with a backsaw and a rasp. The fenders help in alignment.

Shape the fenders as nearly complete as possible before assembly. Then glue all parts together, holding them with thin nails driven through the fenders until the glue has set.

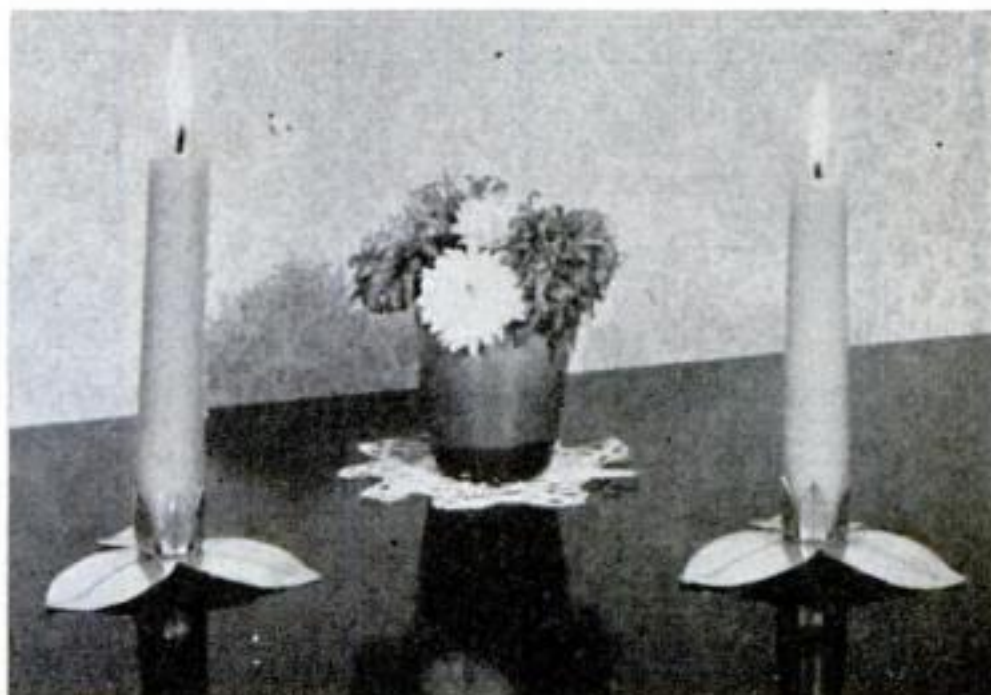
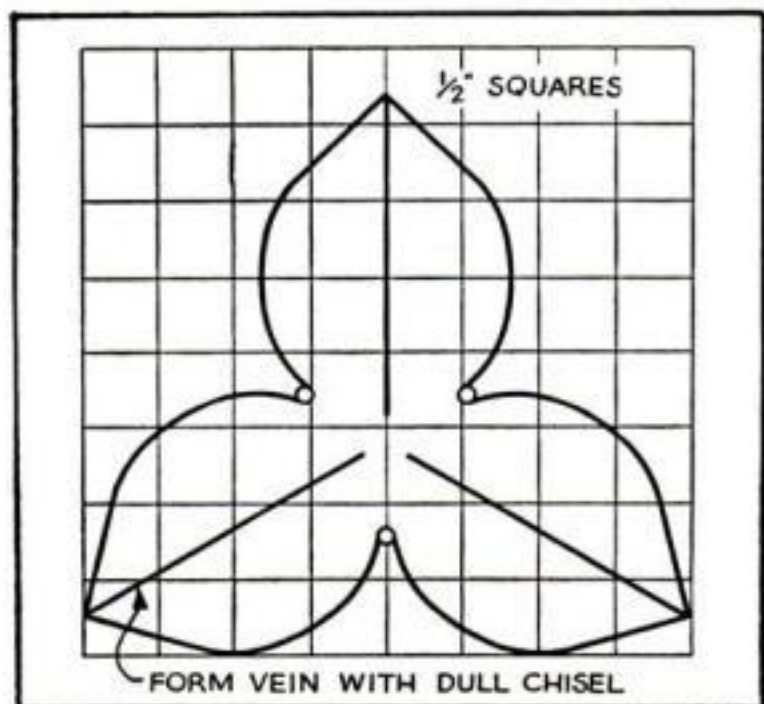
The nails are then drawn out, the holes filled, final shaping and sanding completed, and axle blocks glued on.

Turn the wheels as indicated in the drawing and drill them to revolve freely on nails driven into the axle blocks. The top is whittled to shape and held with dowels.

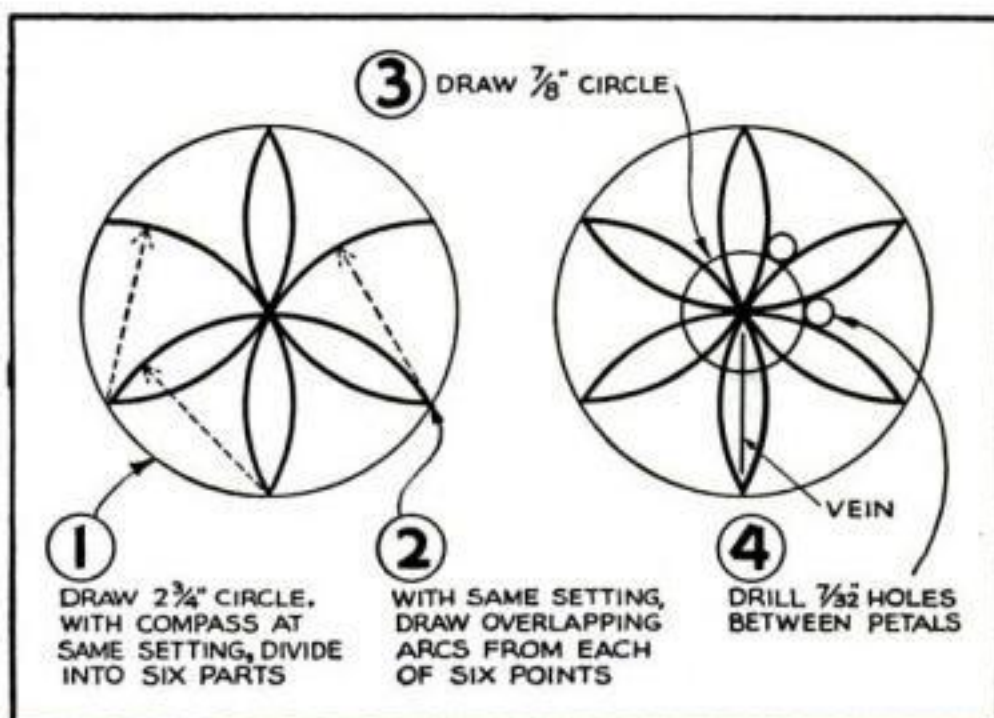
Bumpers may be any flattened tubing or metal strips drilled and attached with screws. Windshield and hood trim are tin-can stock cut into thin strips. Switchboard-lamp caps, available at electric and radio shops, make excellent head lamps. Finish with good enamel.—H. R. CORRY.



Candleholders in Floral Designs Formed from Sheet Copper



CANDLEHOLDERS in attractive floral designs can be cut and bent to shape from 22-gauge soft copper. Mark off two sections as shown. Holes drilled between the petals make a neater job of cutting out the parts with tin snips. Indent the veins with a dull cold chisel, rub down both parts with coarse steel wool, and mark the veins with black India ink. A $\frac{7}{8}$ " steel rod will facilitate bending up the small petals. Drill a hole in the center of each piece and fasten them together with a machine screw and nut. Bend down the base petals slightly.—WALTER F. DEBOLD.



Veneer Card on Name Plate

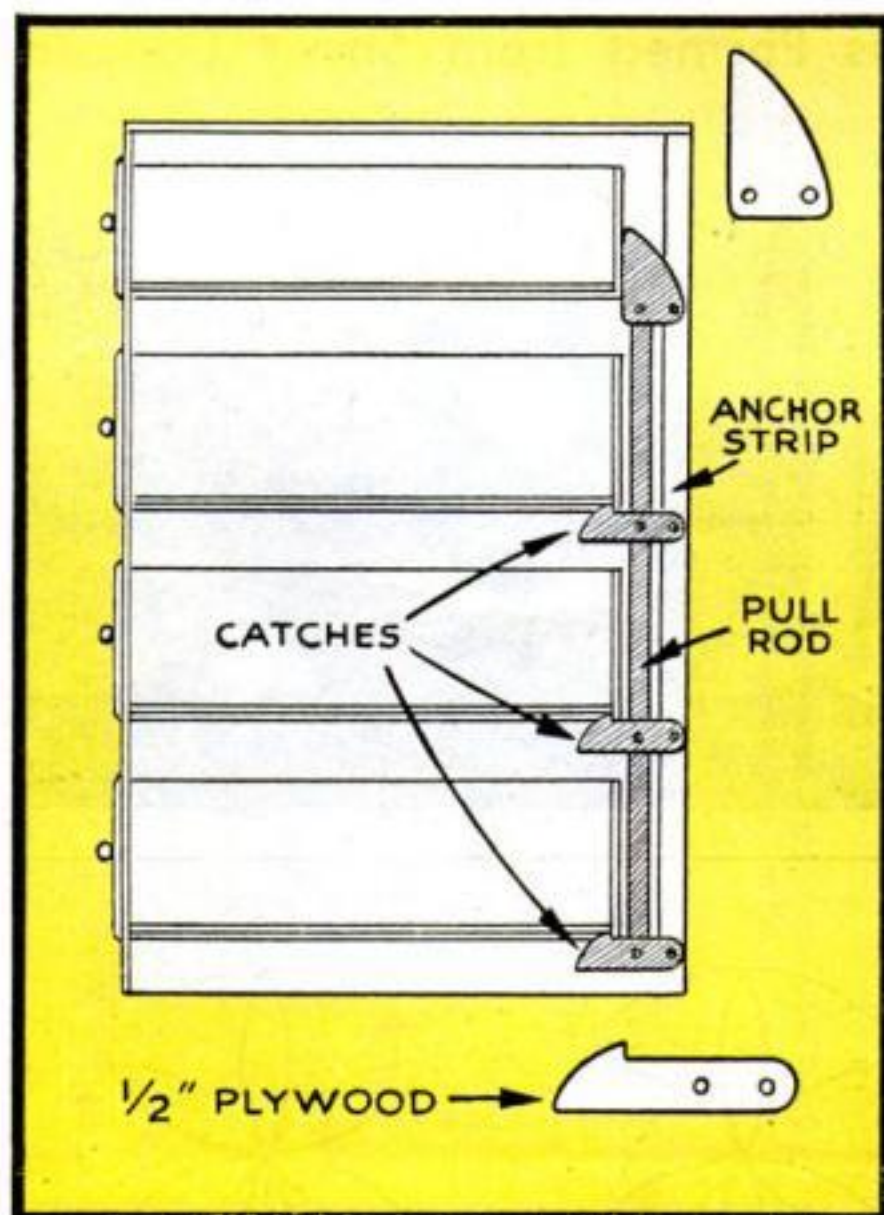
MOUNTED on a tapered block of well-sanded hardwood, a bit of veneer makes an impressive title card for a desk name plate. The name may be hand lettered or, if you wish, a printer will do the job at small cost. Fold a piece of clear sheet acetate around the title card before attaching it with two upholster's nails. The plate shown is a $1\frac{3}{4}$ " by 5" piece of birch veneer on a 2" by $5\frac{1}{2}$ " walnut block tapered from $\frac{3}{4}$ " at the base to $\frac{1}{4}$ " at the top.—LECIL J. SLABACK.

Lens Holder Bent from Piece of Wire

BENT to shape from a single length of wire, this lens holder has a viewing angle of about 60 deg. from the vertical, a position often more convenient than the usual 90-deg. angle of table magnifiers. However, the lens can be placed in a horizontal position simply by changing the angle of bend between the uprights and the lens. Spring tension holds the lens in two wire rectangles. The height of the holder will depend on the best working distance of the lens.—ROBERT SCOTT.



KEEPING



You can save your youngsters as well as your linen from harm by building into your chests an automatic lock operated by the top drawer. Make the parts of $\frac{1}{2}$ " plywood to whatever size is allowed by the chest itself. Use loosely pivoted wood screws for all joints so that opening the top drawer will permit the catches to fall of their own weight. Sand all contact surfaces.

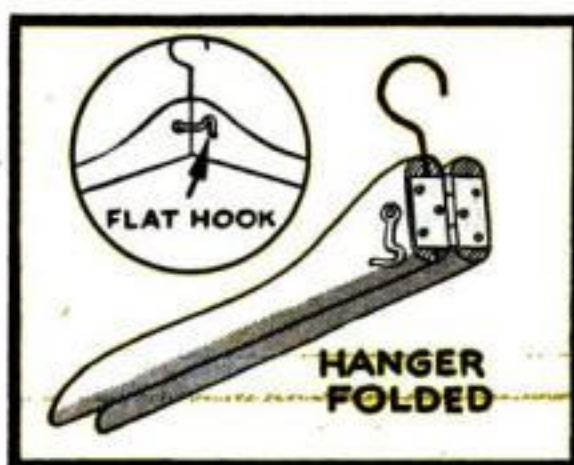
If your loose phonograph records are hard to find and easy to break, keep them safe and handy by gluing individual folders inside the covers of your albums. An alternative method is to hinge the folders with strips of wide adhesive tape. For safety's sake, don't add more than two extra records to any album as this may make the volume too bulky and increase the possibility of damaging the records.



Rosebush thorns make it difficult to cut the flowers as you'd like, but you can outwit them by using a spring clothespin to hold the stem while you ply your scissors.



Coat hangers will take less room in crowded suitcases if you cut and hinge them at the center as shown. A flat hook placed across each hanger locks it when open.



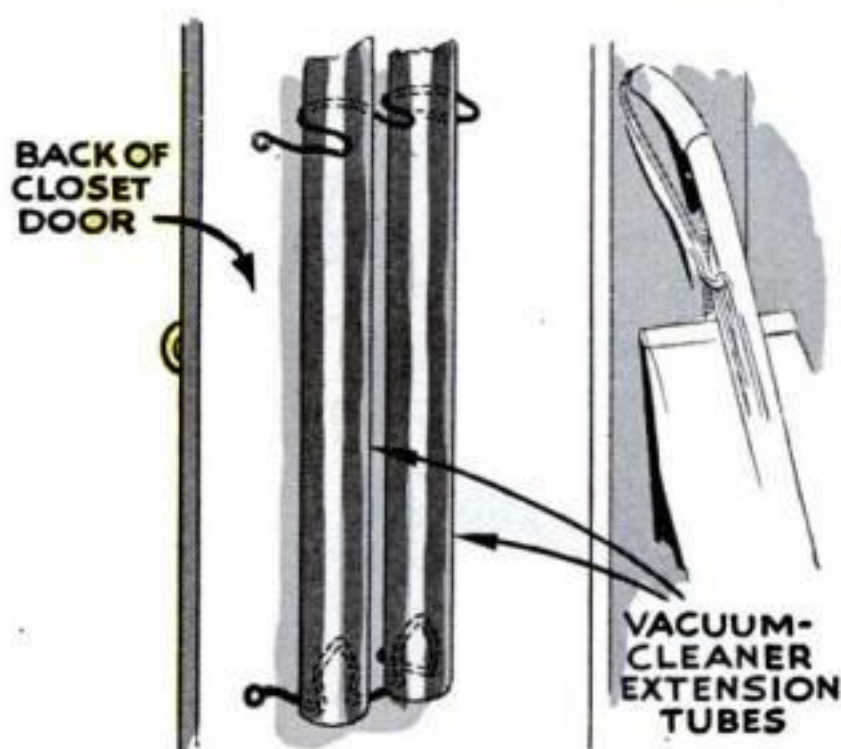
Ordinary corrugated fasteners can be used to slice pickles, olives, and similar delicacies for use in fancy salads. Hammer the fastener into a dowel or a wood strip.



THE HOME SHIPSHAPE



To loosen a paint-jar cap that is stuck tightly, rotate it over the flame of a match. One or two matches should suffice. Use a cloth to grip the hot metal. Repeat the treatment if necessary.

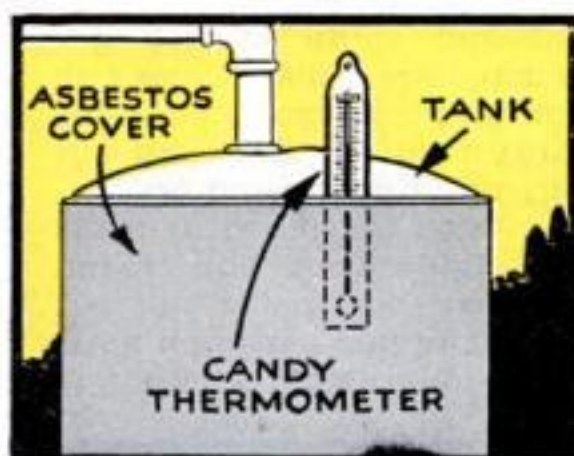


Clips made of coat-hanger wire and nailed to the back of a closet door will keep vacuum-cleaner extension tubes within reach. Bend the wire as shown in the drawing. To obtain a snug spring fit, use the tube itself as a pattern for making the clamp.

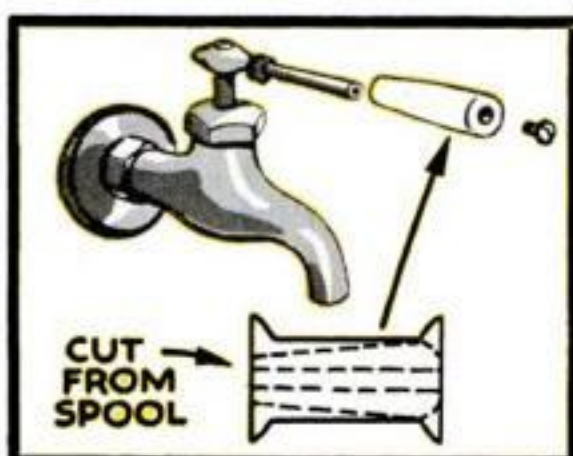


Instead of bringing up an extension light or finding someone to hold a lamp when you want to drive a nail in a dark corner, punch the nail through the center of a scrap of white paper and hammer away. The paper will provide enough contrast for vision.

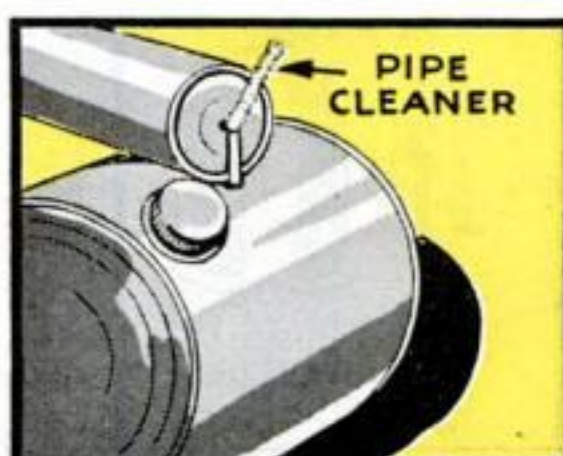
Inserting a glass or metal-backed candy thermometer under the cover of your hot-water tank will enable you to keep a check on the temperature of the hot water.



If you need an emergency replacement for the porcelain handle of a kitchen faucet, shave the edges down on a large thread spool with a jackknife or rasp.



After applying paint with a spray gun, insert a pipe cleaner in the reservoir tube to keep the passage clean for the next use and to prevent clogging of the tube.



What's Wrong?



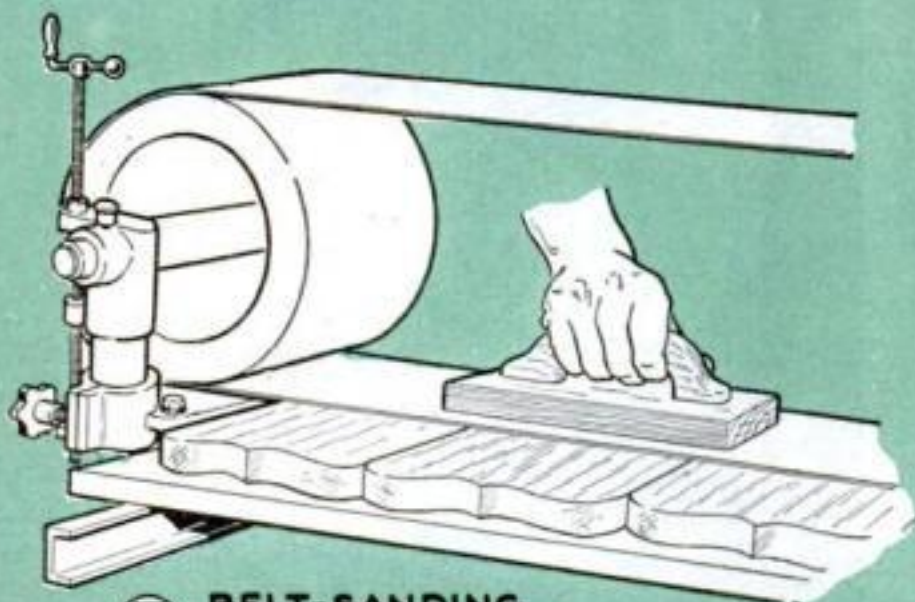
1 PIECING SEGMENTS OF PAPER ON A SANDING DISK



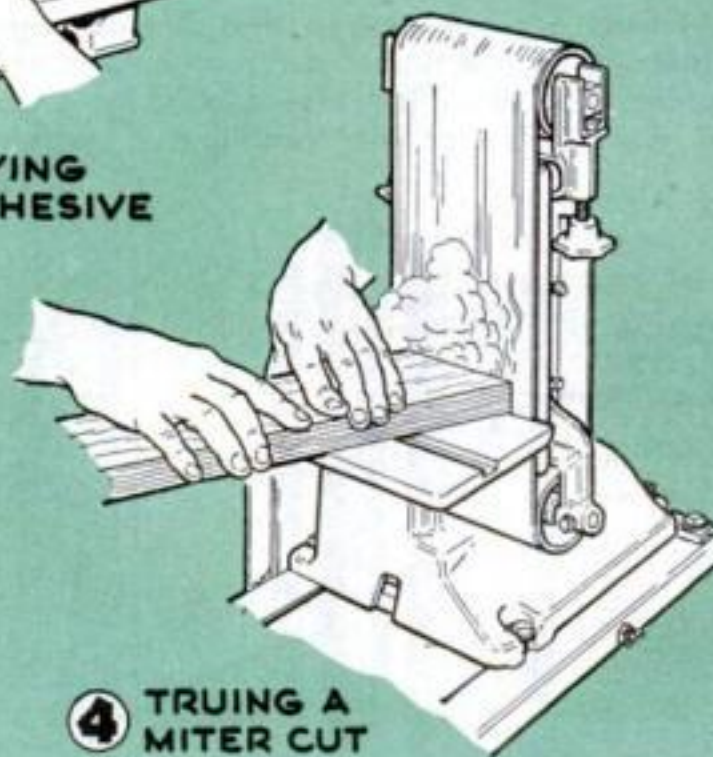
3 APPLYING DISK ADHESIVE



2 SMOOTHING A CURVE



5 BELT-SANDING DUPLICATE WORK



4 TRUING A MITER CUT

CAN you find six sanding errors in the drawings—two in No. 4? The correct answers are given below.

1. Pieced disks applied directly with stick adhesive will be thrown off. Back the joints with pasted cloth or strong paper, and then apply the assembled sheet in the usual way.
2. Do most sanding at the side where the disk travels downward and keeps the work from rising. Sand on the "up" end only when a shoulder requires it.
3. Always apply adhesive with the stick resting on a block of wood. This prevents fouling of the table with blobs of melted adhesive.
4. Here are two errors. Never true an end without using a miter gauge or jig and don't apply pressure that will burn the wood and clog the grit.
5. Sanding across the grain scores the stock. Take care to arrange the pieces with the grain running parallel to the motion of the belt.



"He was here a minute ago."

How to Go Aloft Safely

By ELON JESSUP

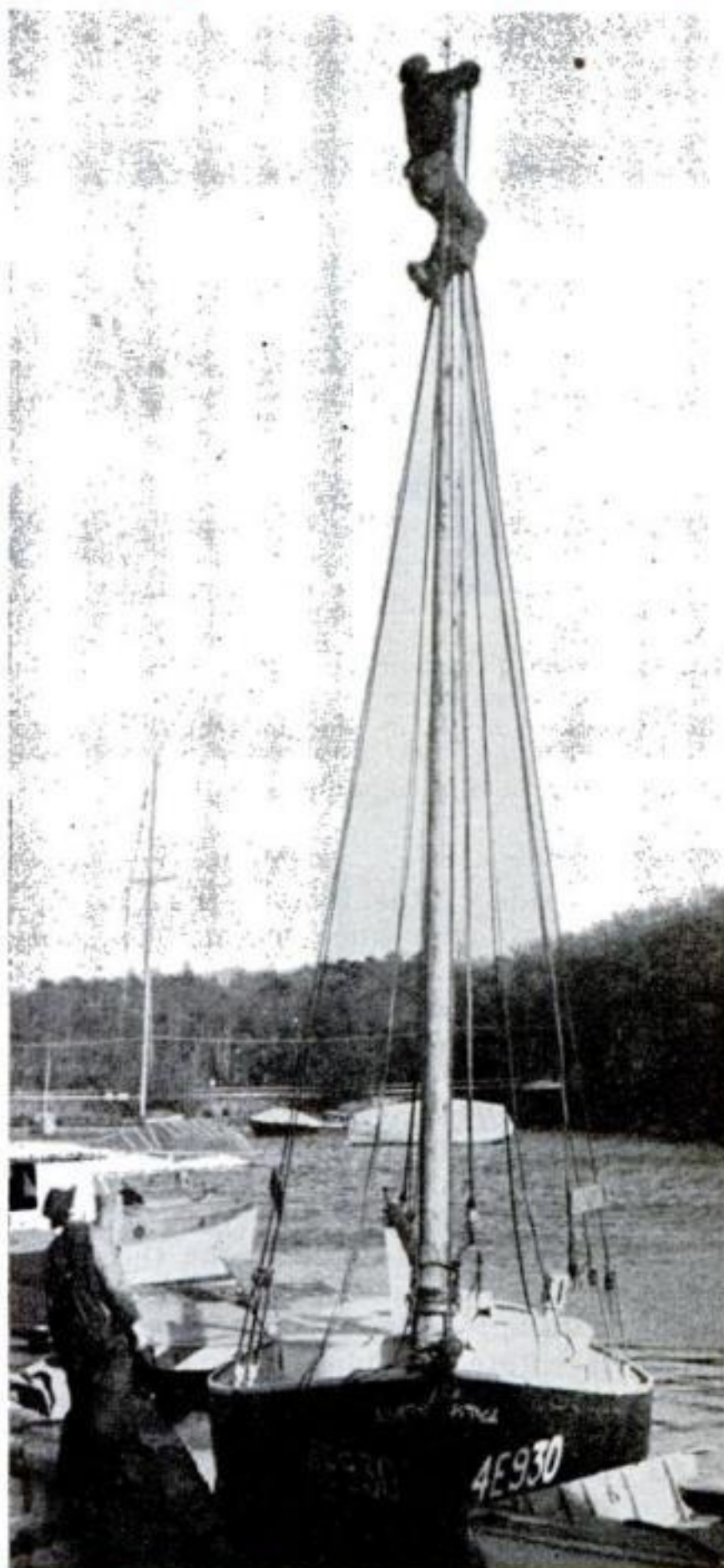
MASTHEAD watch for whales may be a thing of the past, but sailors are still called upon occasionally to go aloft. When gear has fouled and can't be cleared from deck, or an old halyard has let go and a new one must be reeved through the block, there is nothing else to do. This is true, too, when a mast must be cleaned and varnished.

And the masthead watch itself is staging a comeback. Not for whales, to be sure; but rather for big-game fishing and distant cruising on inland waters. A scarcity of markers and the presence of underwater obstacles could get a boat into trouble if it weren't for the masthead watch.

Methods of going aloft have always been curiously varied, but the essentially practical ones for average pleasure boating number only four. One is skinning up bare shrouds; another, shinning up the mast; a third, using a bosun's chair; and the fourth, walking up ratlines.

Any Down East deep-sea fisherman can show you how to skin up a pair of bare shrouds. Nowadays the fishermen don't practice this method so much, for the modern fishing dragger's shrouds are usually ratlined. Climbing unratlined shrouds has actually become more suitable for pleasure craft—something plenty of yachtsmen haven't overlooked.

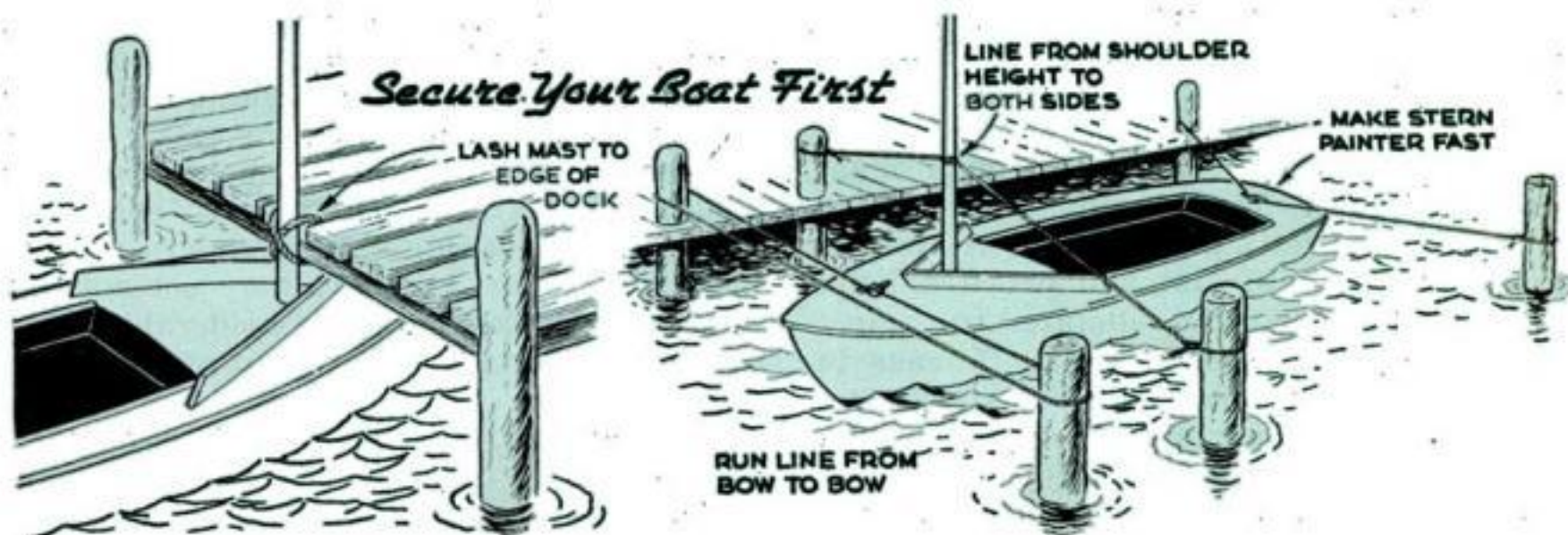
The knack consists largely of squeezing



\$500 in War Bonds

TO HELP YOUR SHIP COME IN

PRIZES for the best ideas about the boat you want to own. See page 172.





Taking it easy on a pair of shrouds. The Down East fisherman at left, up for observation, wears sea boots to help his legs grip the shrouds. Ratlines on the powerboat at center are solely for reaching the light. At right, the sailor uses the narrowed ends of shrouds for holding on while engaged in a task on the masthead.

the inner side of the foot at the toes and the outside of the knee against the wire or rope. Then the shroud crosses over the foot and in front of the leg. Overhand reaches for more altitude take care of the rest. Fishermen usually climb in their sea boots. The rubber helps their legs to stick.

Given the choice between shrouds and a smooth mast, fishermen take the shrouds every time. Many an owner of a small to medium-size sailboat will prefer the mast.

Make sure before starting up that your boat can take it. The mast becomes an up-turned weighted pendulum, and a small boat is likely to roll and may even tip over. If you have any doubts, nose her beforehand between a spile and a wharf, and then run a line to each side from the deck or low on the mast.

You will usually have a halyard to serve as a convenient handhold while climbing, or you can grasp the shrouds of a narrow boat. There is an old custom on deepwatermen that is worth bearing in mind, if you live on salt water. Try going up a mast barefooted after first dipping your feet in salt water and letting them dry. A coating of salt will remain and will prove a help.

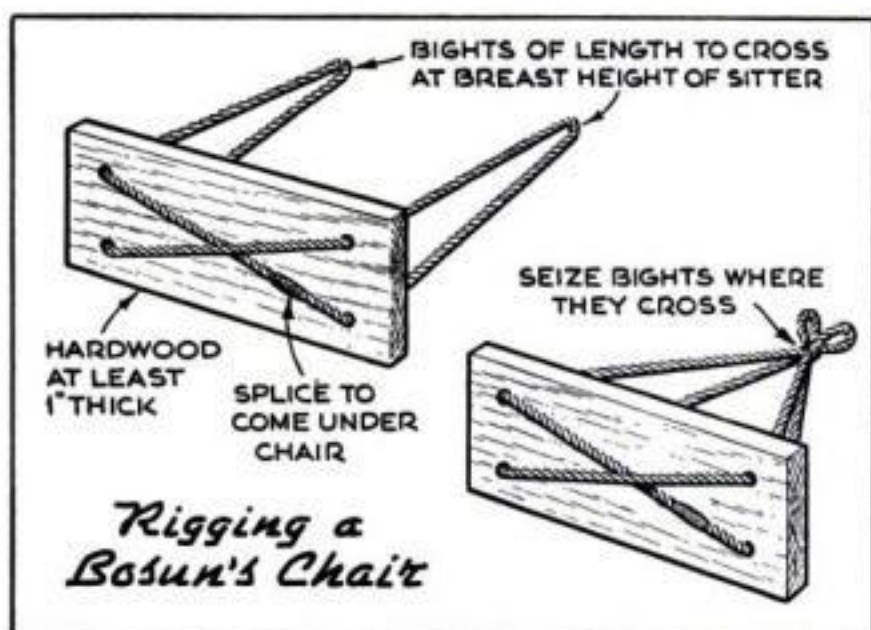
Circumstances often dictate the most suitable method of going aloft. A case in point is the famous and familiar rig known as the bosun's chair. Don't try one in a seaway. Most sailors concede now that swinging in a bosun's chair in a seaway is

doing a job the hard way. The bosun's chair belongs in port for jobs like painting.

Aloft in a bosun's chair in its proper place, you will probably be more firmly seated than appearances suggest—but only if the seat is solid hardwood at least 1" thick, if the halyard and block can be counted on to hold you, and if the supporting bridle is adequately rigged on the seat. Criss-crossed lines under the seat are recognized as the safest rigging, for then, in the untoward event of the seat splitting, you will be left sitting on the lines.

Usually the occupant of a bosun's chair is hoisted and lowered by a shipmate on deck. Hoisting and lowering yourself is possible, but hoisting especially is not to be recommended. No matter which way you go, though, remember the old saying: one hand for the ship and the other for yourself. You can't know for certain the strength of the block aloft until you reach it, but you can keep a leg hold on the mast and one hand on a shroud or stay. A sail stop encircling your body and the mast isn't a bad idea. You can become so engrossed in a job of cleaning the spreaders or varnishing the mast that you may not notice a powerboat kicking up a considerable wave across the harbor. That kind of thing can swing a bosun's chair out and slam it back with a wallop that could seriously injure you even if it didn't unseat you.

For general fitting-out in port you may



require a bosun's chair, but for observation outside and for reaching gear, ratlines are the safest, most comfortable, and most generally satisfactory means of going aloft. The shrouds are already there and, once installed, ratlines eliminate the fuss and bother of rigging up a bosun's chair.

A good many of the new sports fishing boats carry ratlines, and occasionally, too, you will find them on powerboats solely for the purpose of reaching a light. Large yachts, of course, have been carrying ratlined shrouds ever since anybody can remember. They are out of place on small sailboats, but they can prove of special value on medium and large ones. Although a certain amount of windage is inevitable, it can be halved by installing ratlines on only one side of a boat.

Pleasure craft once almost invariably used rope ratlines, but recently a number of them—especially powerboats—have taken to wood and pipe. You may prefer the appearance of rope, but wood or pipe ratlines offer firmer and more comfortable footing.

If, in spite of this, you must have rope, use a light, tarred, 12-thread line $\frac{3}{8}$ " or more in diameter. Lengths are cut to conform to the spacing between the shrouds with enough extra allowed for making the



Aloft in a bosun's chair belayed to the deck, the seaman here employs one hand in work on the mast while keeping the other on a shroud for safety.

ends fast. Long ratlines can be shortened by twisting, but short ones can't be lengthened. To determine the number, figure 15" to 18" as a comfortable climbing step.

Before attaching the ratlines, or even cutting them, serve the shrouds with tarred marline or a few rounds of spun yarn to keep the ratlines from slipping. Friction tape can be used, but it doesn't look so well. You should also seize on a number of strong temporary battens to hold the shrouds rigid,



Wood ratlines are often notched near the ends, as shown below. The notches hold the turns of marline in place, as at right, when the ratlines are seized on the shrouds. Spun-yarn servings on shrouds prevent slipping under weight.



Stout ratlines are the safest and most generally satisfactory means of going aloft. Here a sailor stands on one ratline to make another fast above.

support you as you work upward, and enable you to get correct measurements between shrouds as well.

Ratlines may be attached with a clove hitch, but the more usual method—and also the more presentable—is with an eye splice. In either case, the knot is seized to the shrouds with rounds of marline. If you have a series of shrouds to deal with, use eye splices for the two outside shrouds and clove hitches for those intervening. The hitches must always face outward.

Any material used for wood ratlines should be sturdy hardwood that will take the tread of a heavy man in a rolling seaway. Rungs from a ladder are sometimes used. Down East fishermen go for oak 1" square. They set a sound example.

Serve the shrouds first with tarred marline or spun yarn, as in rigging rope ratlines. You won't need temporary battens. Methods of attachment vary. One is to notch the front and back of the ratlines about 1" from the ends. The notches on the back snug into the two shrouds, and a simple seizing on with marline takes care of the rest. Notches are not so essential on the back, but those on the face keep the marline from slipping off.

Another way is to cut grooves in the ends for the shrouds to fit into. Ratlines grooved this way do not overlap. Drill a small centered hole through the face about 1" from the ends, put several turns of marline



through, and seize around the end of the ratline and above and below on the shroud.

Ratlines of pipe are put on with linen seizing and the seizing is then shellacked. The seizing shrinks as the shellac dries and will hold with great strength.

\$ 5 0 0 0 0 in WAR BONDS

Prizes Awarded for the Best Design Ideas by Boat Lovers

ARE you a salt or a fresh-water skipper? Do you like to sail or do you favor powerboats? What is your idea of an ideal boat? Is it a cabin cruiser, a speedboat, a fishing smack, or a ketch or yawl? Whatever it is, just so it is no more than 35' long, POPULAR SCIENCE MONTHLY will pay for the best ideas.

First Prize.....	\$250 War Bond
Second Prize.....	\$100 War Bond
Third Prize.....	\$50 War Bond
Fourth Prize.....	\$25 War Bond
Fifth Prize.....	\$15 in War Stamps
Sixth Prize.....	\$10 in War Stamps
Ten additional prizes.....	\$5 in War Stamps

You may enter as many designs as you like, but only one prize will be awarded any contestant. Entries should consist of

the following: one or more drawings, which may be in pencil; a description in not more than 500 words; an estimate of cost, stating whether the estimate includes only materials, materials and labor, or purchase price if it is the boat you'd like to buy; a declaration that the design is original with the contestant. Be sure to state what you wish to use the boat for.

Send entries to the Small-Boat Contest Editor, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York 10, N. Y., bearing a postmark not later than November 30, 1945. The contest is open to all except naval architects, professional boat builders and designers, employees of this magazine, and their families. Duplicate prizes will be awarded for ties. The decision of the judges will be final.

Aircraft Metals in the Home Shop

By WALTER E. BURTON

ONE of the most plentiful metals in the postwar period is likely to be aluminum. It is bound to find its way into the home workshop where the craftsman will, in many cases, prefer it to steel and other metals because of its cheapness, strength, and lightness, and because of the ease with which it can be worked.

Aluminum melts at 1,220 deg. F. Scrap pieces can be melted in a crucible in almost any kind of furnace and then cast in sand or iron molds. Aluminum for casting is generally alloyed with about 8 percent copper. Another aluminum alloy, especially suitable for gears and other cast parts for salt-water craft, contains silicon and a trace of iron. One small shop, using broken-up auto-engine heads and similar scrap, had trouble getting clean-cut castings until a little scrap zinc was added. Common alloys weighing a third as much as brass have a tensile strength of about 20,000 lb. per square inch. Cast aluminum and soft sheet are rated at about 15,000 lb.

An abundance of airplane scrap and surplus materials promises to make duralumin a common word in almost every shop. This important alloy is about 95 percent aluminum with up to 4 percent copper and equal or nearly equal parts of manganese and magnesium. One of its properties is an ability to gain other qualities simply through heat treatment and cold-rolling. Tensile strength can thus be increased to 70,000 lb., as great as that of some steels.

If you should acquire sheet aluminum alloy that is too brittle to be bent without breaking, try annealing it by heating to about 700 deg. F. and then letting it cool in



Stabilizers in cathedral-like array as they await assembly on the fuselages of planes. Home craftsmen may soon be using scrap or surplus aircraft metals.

air. Aluminum is generally heated in salt baths in commercial processes, and the time and temperature are watched carefully.

Spun aluminum makes interesting projects. Bowls and similar pieces can be spun in an ordinary metal lathe. Use a fairly high speed and lubricate the tools with petroleum jelly. Bowls, platters, and the like can also be formed by hammering.

Aluminum oxide, forming naturally in a thin coating on the surface of aluminum, is one of the hardest substances known and is, in fact, an ingredient of some grinding wheels. The oxide makes aluminum difficult to solder. It may be polished off with steel wool, fine abrasive cloth, or prepared aluminum polish, but heat accompanying soldering causes renewed oxidation. A special aluminum solder is required, some makes being used with a flux and some not. Generally the best method of heating is with a torch developing a pointed flame, but soldering irons of nickel are also employed.

Welding of aluminum can be done with a

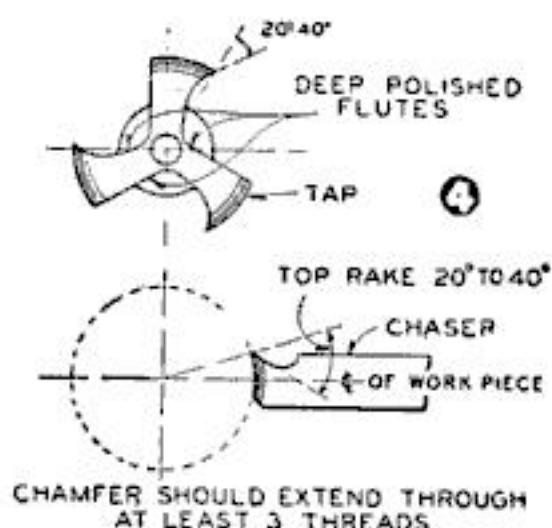
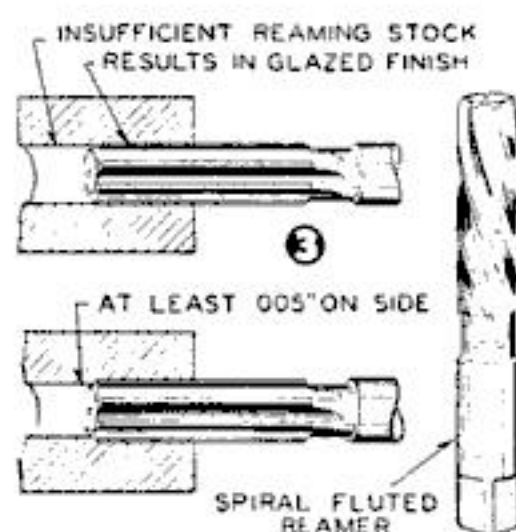
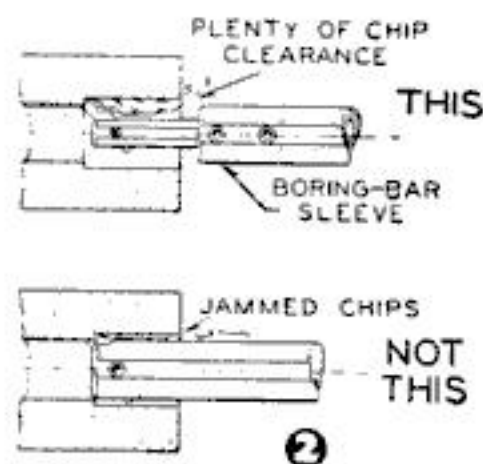
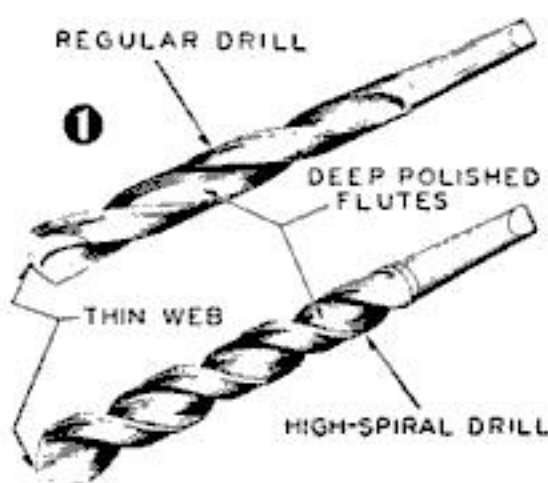
Tips on Machining Aluminum

ALUMINUM may be machined at about the same rate as brass and much faster than steel. Comparatively low speeds are useful in roughing cuts where there is a hard abrasive outer surface, but often the only limit to cutting speed for aluminum is the top speed of the machine itself. The machining tips that follow were compiled with the aid of *Blue Chips*, a publication of the Operators Service Bureau of the Warner & Swasey Co., of Cleveland. All the drawings are from *Blue Chips*.

1 Providing for a free flow of chips is the principal problem in drilling, and for this reason a standard twist drill having polished flutes and a thinned web is generally the most satisfactory. Deep holes are drilled best with a bit having a high spiral angle. Such a drill cuts freely and has more chip room in the flutes. Drills must be kept sharp.

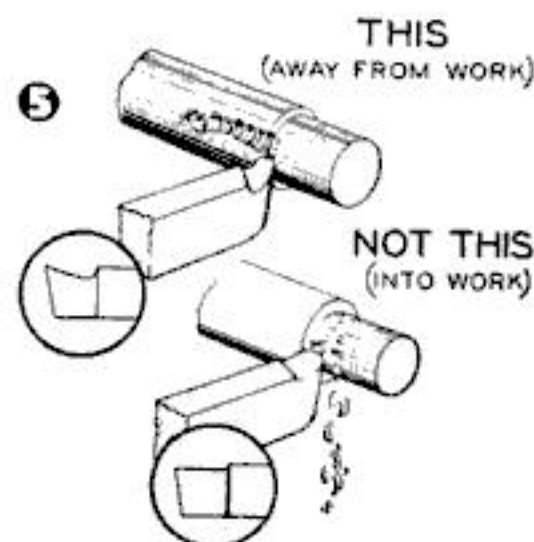
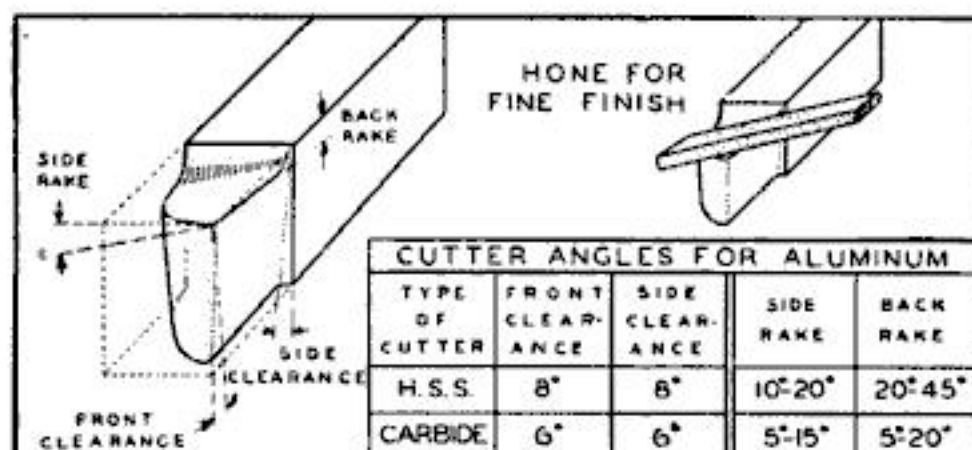
2 As much clearance as possible is essential around a boring bar to keep chips from jamming. Since the chips are work-hardened, they can spoil the finish.

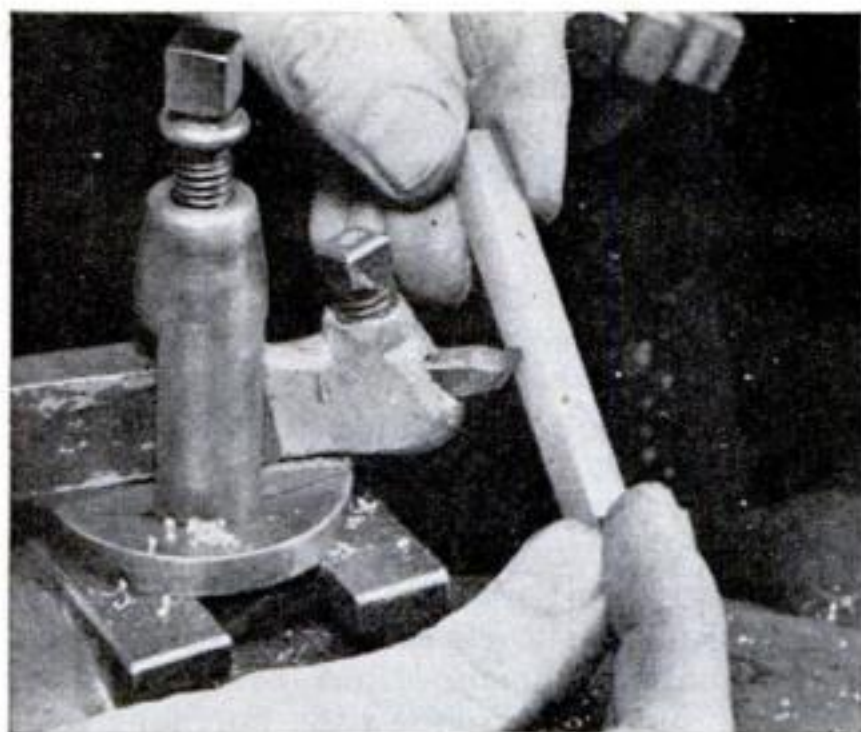
3 A reamer must actually cut aluminum because the metal is spongy, so enough stock must be left to keep the tool from squeezing and burnishing the work. Spiral-fluted reamers have a free cutting action and are often used. They should be properly ground. A speed as high as 400 surface feet per minute is possible.



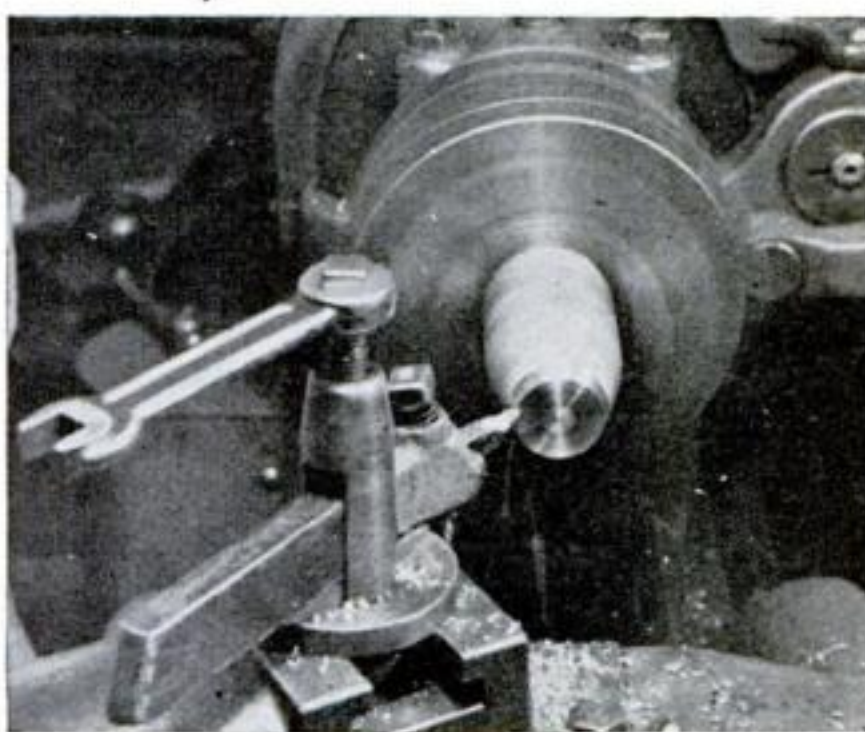
4 Care is required in tapping and threading. Use ground-type taps with a "hook" or rake on the leading edge of the flutes. The flutes should be deep and wide to provide chip clearance and avoid jamming that may ruin the thread. Both dragging and forcing a tap or die head may destroy the accuracy of the lead.

5 Lathe bits for machining aluminum are ground differently from those used on steel. A table of clearances and rakes is given in the drawing. For a good finish, the chips must not drag on the previously machined surface. Aluminum can be machined dry. If a lubricant is used, it may be a mixture of soluble cutting oil and water, kerosene and lard oil, paraffin (oil) and lard oil, or water or kerosene alone.

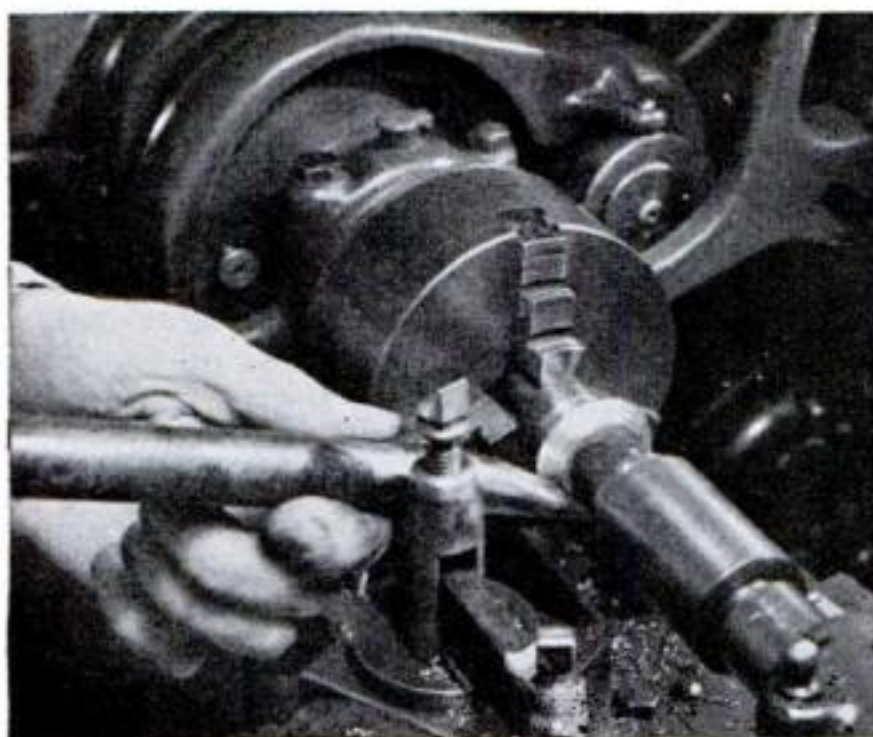




Honing the cutting edge helps to keep tools sharp for machining aluminum. As in lathe work on other nonferrous metals, keen-edged tools are required.



Aluminum is machined at high speeds, from 200 to 900 surface feet a minute. Note that the tool is set quite high and meets the work at a steep angle.



Sheet aluminum is being spun here in an ordinary lathe fitted with a rotary tailstock center. Do not try heavy spinning in a small precision lathe.



Dipping in lye gives aluminum a satin finish. The piece shown above is the aluminum lens cap being turned from a casting in the photo at top right.

torch when a suitable flux is used. Butt joints seem to be the most successful. The flux, as in all welding and soldering, should be washed off after the operation.

Aluminum articles are polished readily and require no special finish. They can be lacquered or enameled. Crackle and wrinkle-lacquer finishes are common.

An even, satiny matte can be produced by alkalis, as was found some years ago by the head photographer of a large manufacturing concern. He had experienced difficulty in obtaining reflectors for 500-watt lamps and had tried to use aluminum mixing bowls mounted on wooden supports, but they were so shiny that the distribution of light was uneven. Knowing that alkalies attack aluminum readily, he mixed a strong solution of household lye, swabbed it around inside the bowls, and let it bubble and fizz for several minutes. Washed in water,

rinsed in his acetic-acid short-stop bath, washed again, and dried, the bowls became excellent diffusion-reflection mediums. Alkaline solutions such as ordinary lye (sodium hydroxide) and potassium hydroxide are also employed in etching aluminum.

Magnesium is another important war metal likely to find favor in home workshops when extreme lightness is desired. It weighs only 109 lb. per cubic foot compared to 168½ lb. for aluminum. The melting point is slightly lower, 1,200 deg. F. Magnesium may be machined like aluminum, but the metalworker should bear in mind that fine shavings and chips will burn with a fierce heat—the flash powder used by photographers before the advent of the photoflash lamp was chiefly magnesium.

Monel metal, an alloy containing a little better than 2 parts nickel to 1 part copper and a small quantity of other elements, is



Sulphurized cutting oil is a help in drilling tough monel metal. Without it the bit may be burned. A deep punch mark encourages the bit to take hold.

one of the tough guys of the alloy world. It melts at 2,460 deg. F., has a lustrous, silvery appearance when polished, has high ductility and malleability, and resists corrosion. Some of its uses are for photographic tanks and trays, for air ducts and other equipment in factories handling salt and other corrosives, and for kitchen sinks, stove tops, work surfaces, and the like.

Its toughness makes monel sheet difficult to cut with hand snips, though if the necessary force is applied it can be done. A drill bit is likely to burn without warning when you attempt to drill monel unless you employ a trick or two. One such trick in drilling sheet stock is to make a deep punch mark first, one even deep enough to break through, which helps the drill take hold

Old Photographic Hypo Useful for Silver-Plating Brass

THOSE who do their own film processing have a means at hand for silver-plating brass knobs, ash trays, candlesticks, and the like. They can use their old hypo. All that is necessary is to clean the surface of the brass piece to be plated to remove all dirt and grease and to immerse it in the hypo for a short time. The plated piece is then washed well, dried, and given a coating of clear lacquer to prevent tarnishing.

By a process known as chemical displacement, a thin coating of silver is deposited on the brass. This usually requires no more than a minute. Prolonged immersion may result in flaking. Be sure you employ used hypo, or there will be no silver in it.—W.E.B.

promptly instead of merely rubbing over the surface. Sulphurized cutting oil or lard oil is applied to reduce friction and produce a cleaner cutting action. Dry-cleaning fluid, applied liberally enough to prevent complete evaporation by the heat of drilling, will also work. Use a slow drill speed with just enough feed for a nicely curled chip.

Monel can be spun successfully, but it calls for more force than brass, copper, and even many steels. Whenever it becomes too hard and stiff to be spun, it should be annealed by heating to 1,440 deg. F. and cooling in air. Tallow is a good spinning lubricant, and the tools are preferably steel.

Welding, soldering, and brazing monel are not difficult provided the surfaces to be joined are clean. For soft-soldering, the best procedure is to tin the surfaces, using an iron rather than a torch when convenient, and then to sweat the joint together. The flux may be any preparation having zinc chloride as a base—the familiar zinc dissolved in muriatic acid will do, and various commercial fluxes are satisfactory. After the job has been completed, wash off the flux with hot water, scrubbing with a cloth or brush if necessary.

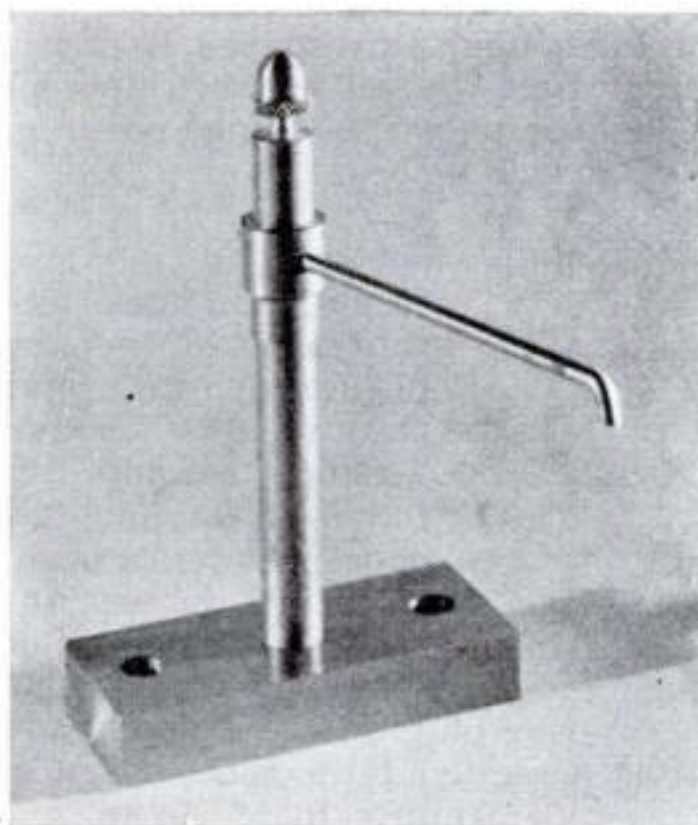
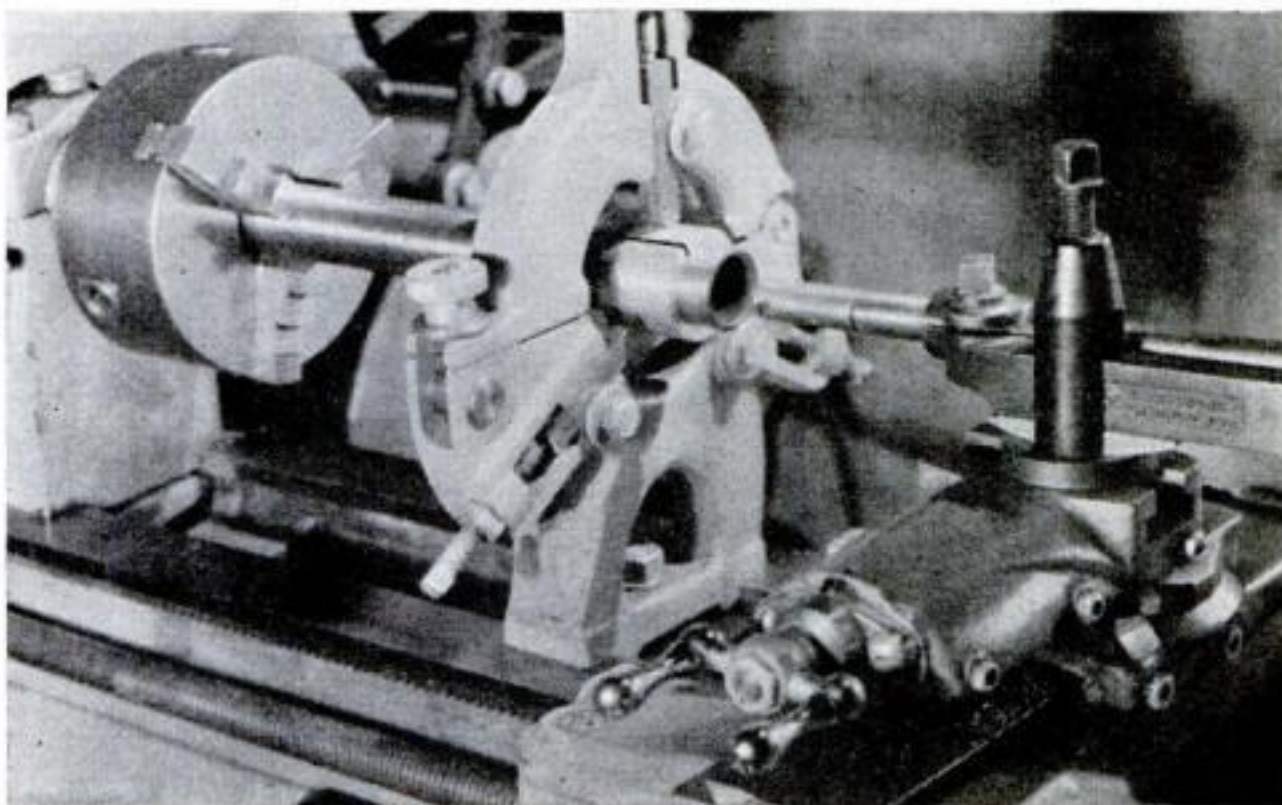
For hard-soldering, use a silver solder melting at 1,400 deg. F. or less and a torch with a small flame. Keep the torch moving so as not to heat the metal any more than necessary to make the solder flow. The same procedure is followed in brazing. Special fluxes for monel are made for both hard-soldering and brazing. No special brazing rods are needed with the right flux.

Monel may be welded with a gas torch, metallic or carbon arc, or spot or seam-welding equipment. Special monel welding rods are made. The current for spot-welding is higher than that needed with steel, but pressure is lighter and time shorter.



Split Bushing in Lathe Steady Rest Protects Finished Surfaces

MARRING of polished work by the jaws of the steady rest can be prevented by a split brass bushing made up to slip over the work as shown in the photo at right. Adjust the jaws until the work is held snugly but will still revolve freely inside the bushing. Such a bushing protects the surface from chips and dirt and, when well oiled, not only guards against scoring but even increases the high polish.—C. W. W.



Gauge Made from Scrap Measures Tool Height

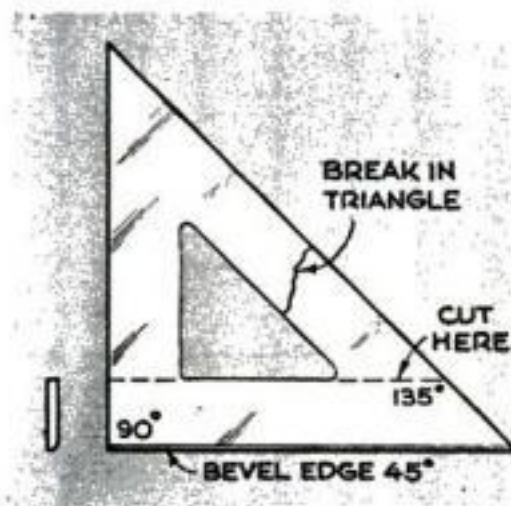
THREADING and cutoff tools that must be adjusted to exact center or other height in a lathe can be set quickly and accurately with the aid of a height gauge made like the one shown above.

Cut the upright member from scrap bar stock, thread the end, and screw it into a suitable base. Make up a collar for a snug sliding fit, drill it clear through, and tap one hole for the height bar and the other for a setscrew. If the bent end is cut to exactly the same length as the distance from the hole to the collar bottom, the upright member can be calibrated.—C. W. W.

Section Cut from Broken Triangle Salvages It for Many Uses

WHEN breaks or chips make a triangle worthless for drawing and layout work in its original form, cut off one unbroken side to make another handy instrument, as shown in the drawing.

Use a penknife and a metal-edged ruler to score both sides where the triangle is to be cut, and then break along the line. Sand the top edge to a bevel and smooth the cut portions. Conventional divisions may be scored at the top edge, if desired, and filled with India ink.—F. S.



Offset File Handle for Wide Work

IT IS often difficult to file a surface with an area wider than the length of the file. Fingers bump the edge of the work when the handle is left off, and uneven pressure causes poor finish. A slight alteration will remedy this.

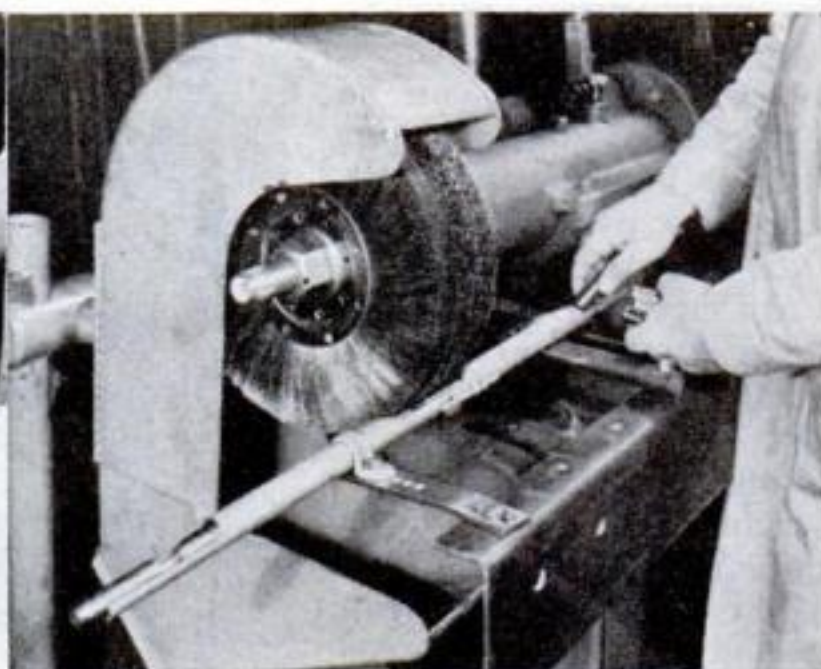
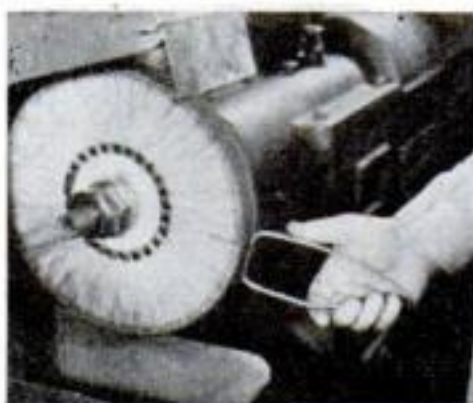
Slip the handle off and heat the tang red hot; then make an L-shaped bend as indicated in the drawing. Be careful not to heat the cutting teeth. The bend should offset the handle just enough to give finger clearance.—JOHN KRILL.



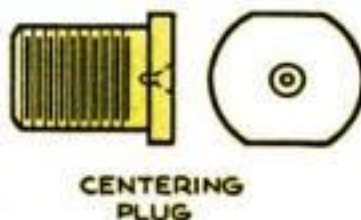
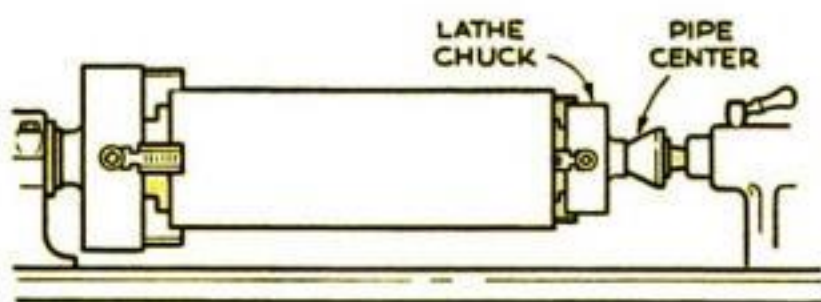
NEW SHOP IDEAS

SELF-FEEDING, the device at the extreme right solved the problem of holding threaded studs against a power-driven brush. The studs fall by gravity through a tube set at an angle, and the brush contacts them through an opening cut in the tube. To keep the studs from passing too quickly, a small stationary brush is mounted to protrude into the tube through an opening opposite the larger one, its friction controlling the time the work is in contact with the rotary brush, which turns each stud until it is past and drops out of the tube.

Such a holding fixture could be made from any metal pipe, but if the part being brushed is soft it would be better to use tubing of plastic or other composition to avoid damage to the external threads. This is one of two handy new shopmade devices for use with power brushes



reported to the Osborn Manufacturing Company, of Cleveland, Ohio. The other is a pair of handmade forceps (at left above) for holding tiny splines against a brushing wheel. A set of such forceps would be useful in handling parts of many sizes and shapes.



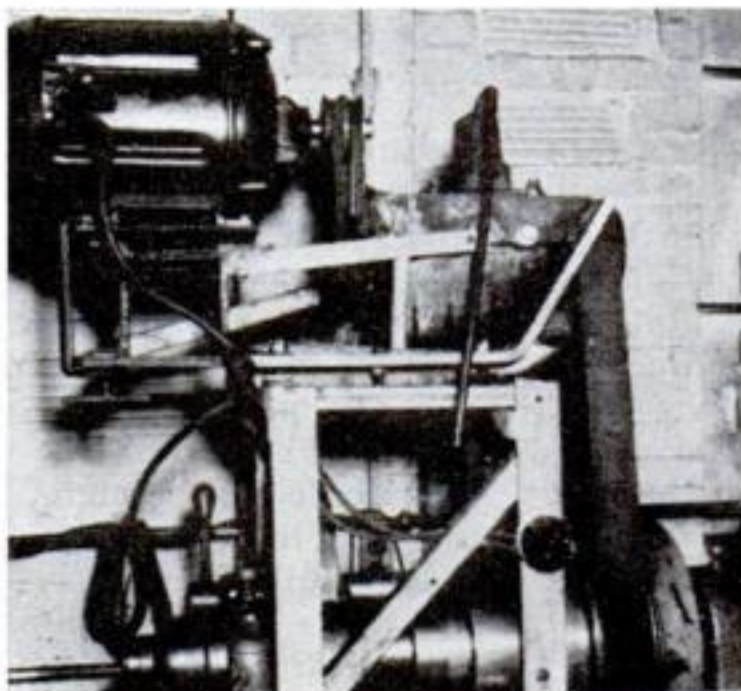
CASING or large pipe too big to mount on available pipe centers in the lathe can be set up securely for turning with two lathe chucks and a small pipe center. Fit the

three-jaw chuck into the inside of the casing and let it revolve on the pipe center, which is set into the tailstock. A four-jaw chuck on the headstock will support the other end of the pipe

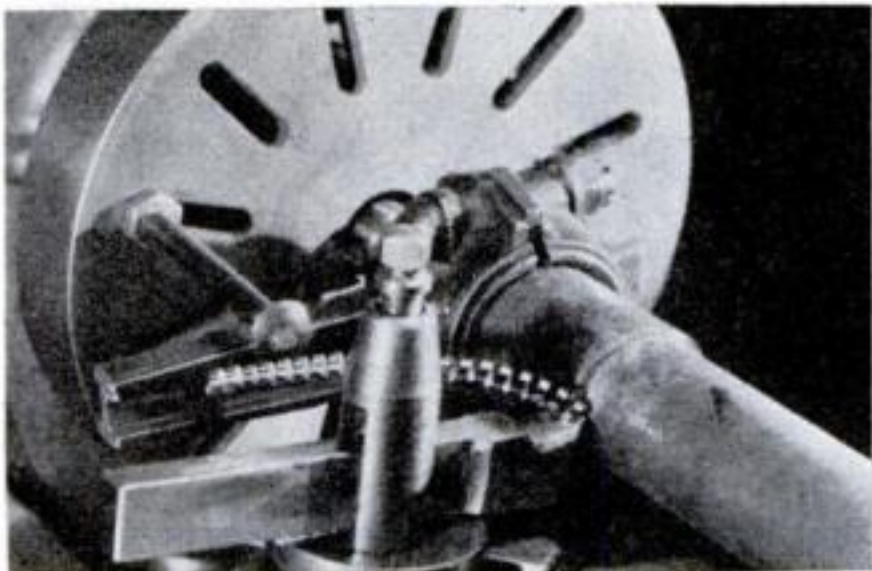
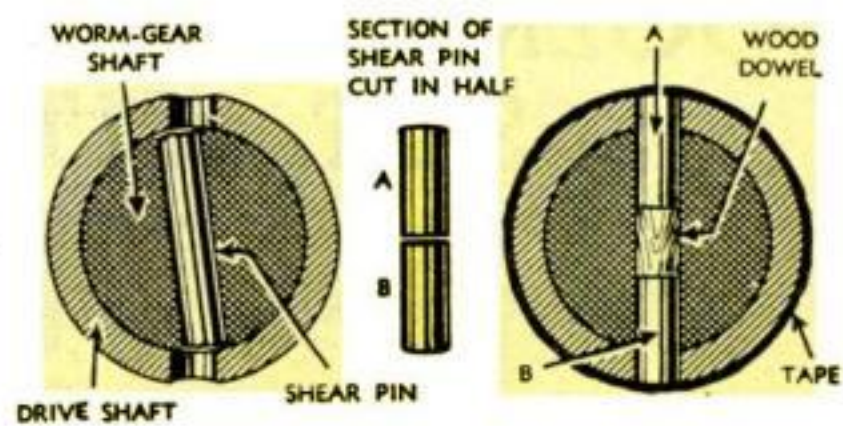
in the usual manner. For repeat work, a threaded centering plug to fit the chuck may be made and a regular lathe center used in place of the pipe center.—R. M. DYKE.

AN AUTO TRANSMISSION will provide speed changes for a large lathe. James W. Kemp, of Santa Fe, N. M., who installed such a system, arranged a double V-belt drive on the power-input side of the transmission by placing a double water-pump pulley on the motor and two pulleys, welded together, on the clutch shaft. On the output shaft he attached a pulley for a flat belt running to the large step of the lathe pulley. He mounted the motor and transmission in a cradle on an angle-iron support bolted to the lathe. Adjustments in the motor mount and trans-

mission support tighten the belts. A pan under the transmission collects any dripping grease. By use of the shift lever, bent down within easy reach, the operator can shift speeds without stopping the lathe.—E. H.

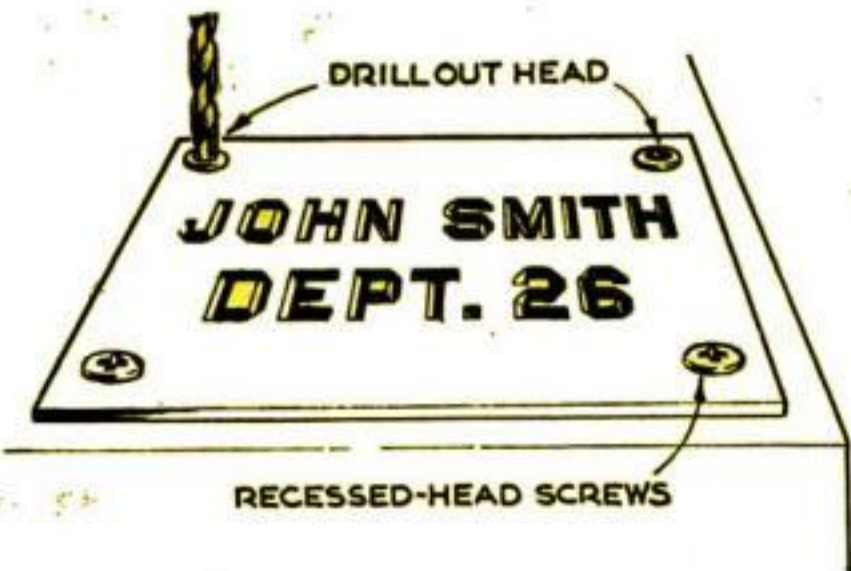
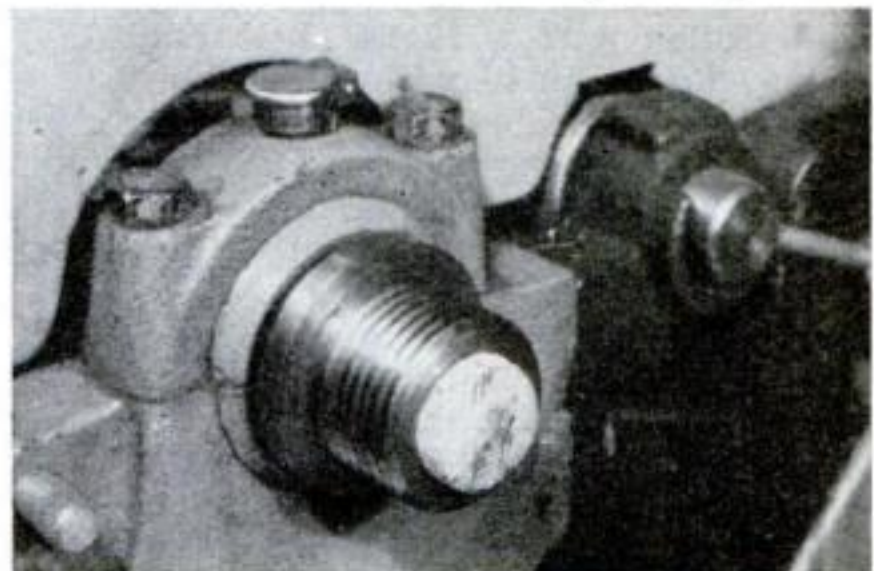


WOOD DOWELS are employed in an emergency method of repairing broken shear pins reported to *Army Motors* by Sgt. Robert H. Fortin. Punch out the piece of broken pin remaining in the shaft, cut it in half, and space out the two sections with a wood dowel, as shown in the sketch at the right, so that they will withstand the force between the driving and driven members. Friction tape wound around the drive shaft will keep the sections of the pin in place if necessary.



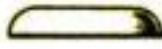

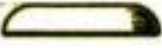

BIG DOG. For oversize work, the makeshift lathe dog shown above will serve the purpose satisfactorily. It was made from a discarded connecting rod with the small end cut off. A hole can be drilled in this end for insertion of a driving stud or a bolt can be fastened in the faceplate slot to drive the lathe dog and the work.—C. W. WOODSON.

A CORK PLUG for the headstock spindle of a metal-turning lathe stays in place better than the usual cloth or wooden stopper. If it's too large, place the cork in the lathe and turn it down with coarse sandpaper. For easy removal, the plug should protrude about $\frac{1}{2}$ ". Insert it in the spindle and cut to that length with a sharp knife.—WILL THOMAS.



NAME PLATES on tool boxes, trunks, or luggage are harder to remove, and therefore make identification more permanent, if attached with recessed-head screws as at left. When the screws are in place, drill out the four-pointed recess to prevent a screwdriver from taking hold. If removal of the plate may be necessary at a later time, it is best to use machine screws so the nuts can be loosened from the inside of the door or container.—WALLACE H. MCCLAY.

DRAWER LABELS like those shown at the right save much time in taking inventory of small parts stored in a stock room, for it is not necessary to count each individual piece. On each card is recorded the weight of the empty drawer and the weight of one of the parts stored therein. Taking inventory thus is reduced to a simple arithmetical problem. Weigh the drawer and its contents, subtract the drawer weight, and divide by the weight of one part. The result is the approximate number of parts.—R. E.

WT. OF DR. WT. OF PART 	WT. OF DR. WT. OF PART 
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TOOLMAKER'S PROTRACTOR IS SET WITH MICROMETER

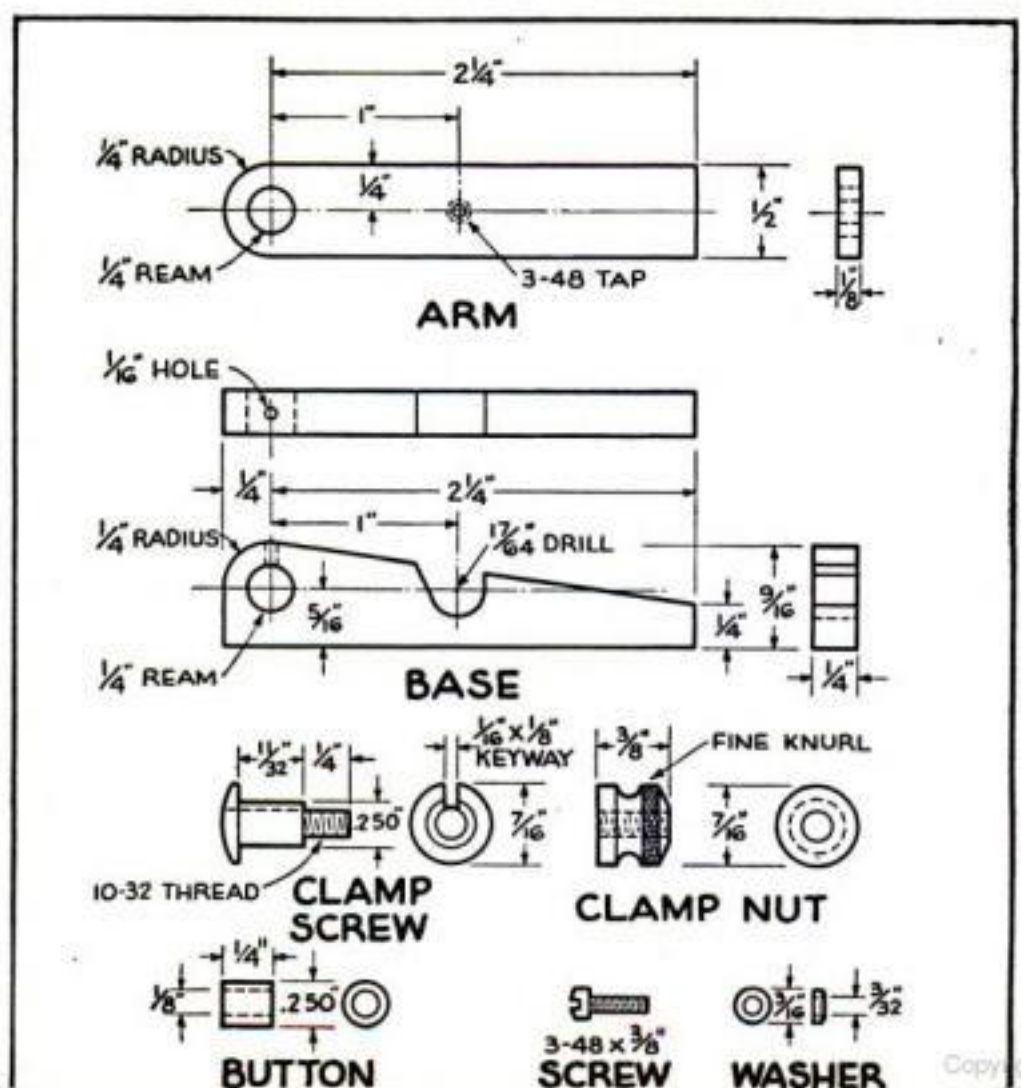
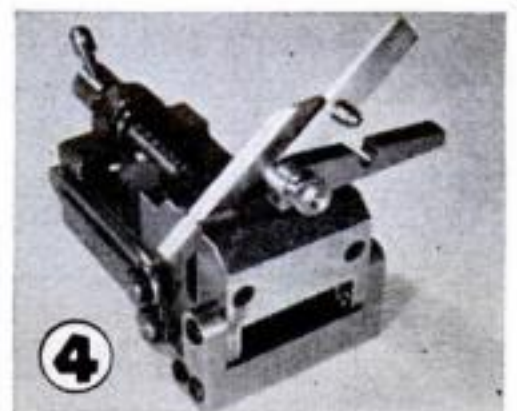
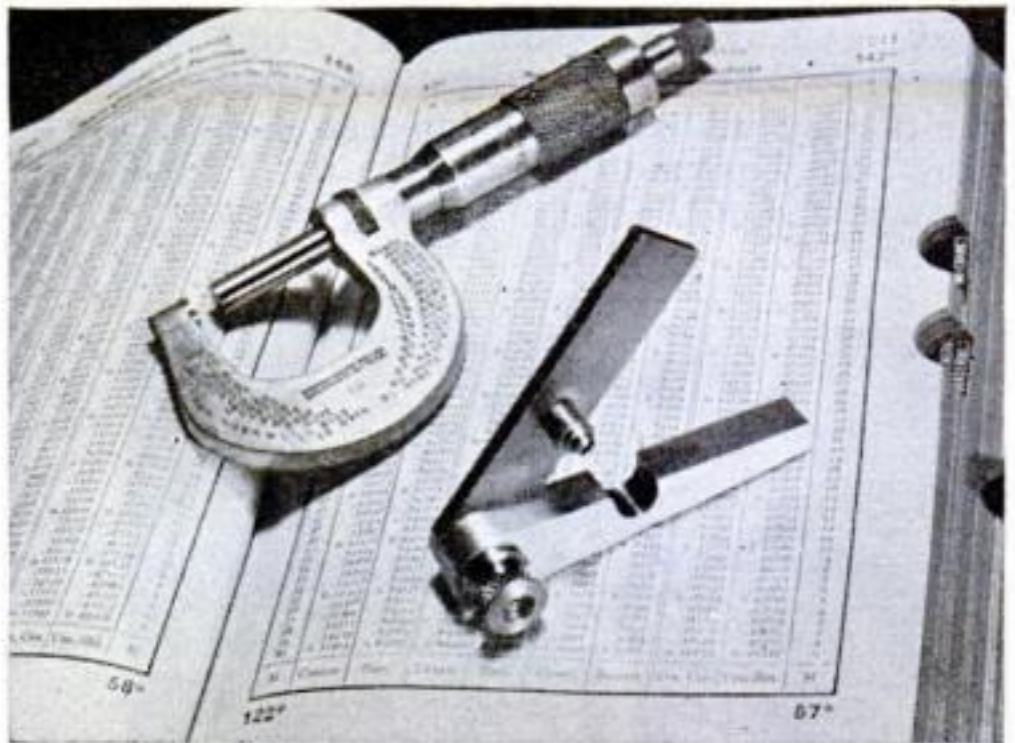
By FRANK McCARTY

ADJUSTED like a sine bar, this miniature sine protractor enables a toolmaker to set up small work for milling, grinding, or shaping uncommon angles accurately to the minute of a degree. With the aid of two micrometers and a table of sines from a machinist's handbook, any angle up to 90 deg. can be quickly determined.

The base is shaped from a rectangular block of mild steel, squared up and drilled with a $\frac{17}{64}$ " hole and drilled and reamed with a $\frac{1}{4}$ " hole located as indicated in the drawing. Insert a short length of $\frac{1}{4}$ " drill rod in the reamed hole for a test plug, and grind the bottom to exactly $.150$ " from the underside of the plug (Fig. 1). This $.150$ " plus the plug or hole diameter ($.250$ ") establishes a constant of $.400$, which must be added to the sine of the angle for which the protractor is being set. The base is completed by trimming off excess stock and filing the $\frac{17}{64}$ " hole to a notch.

Grind the edges of the arm parallel, and drill two holes, as indicated. A clamp screw serves as a pivot, a keyway in it receiving a $\frac{1}{16}$ " pin inserted through the top of the base to prevent rotation when the knurled nut is tightened. The button fits loosely on its screw and can be clamped exactly 1.000 " from the pivot and on a common center line parallel to the edge. The length setting will be 1.250 " between outside diameters (Fig. 2). Make the setting from the edge with a depth micrometer.

Set the protractor by locating the sine of the desired angle, adding the constant $.400$, treating the figure as inches, and measuring from the bottom of the protractor base to the top of the button, as shown in Fig. 3. A 1 " micrometer will measure angles up to 36 deg. 52 min., while a 2 " micrometer will carry the measurements up to 90 deg. Figure 4 shows a lathe bit being clamped in a vise with the aid of the protractor for grinding to an exact angle.



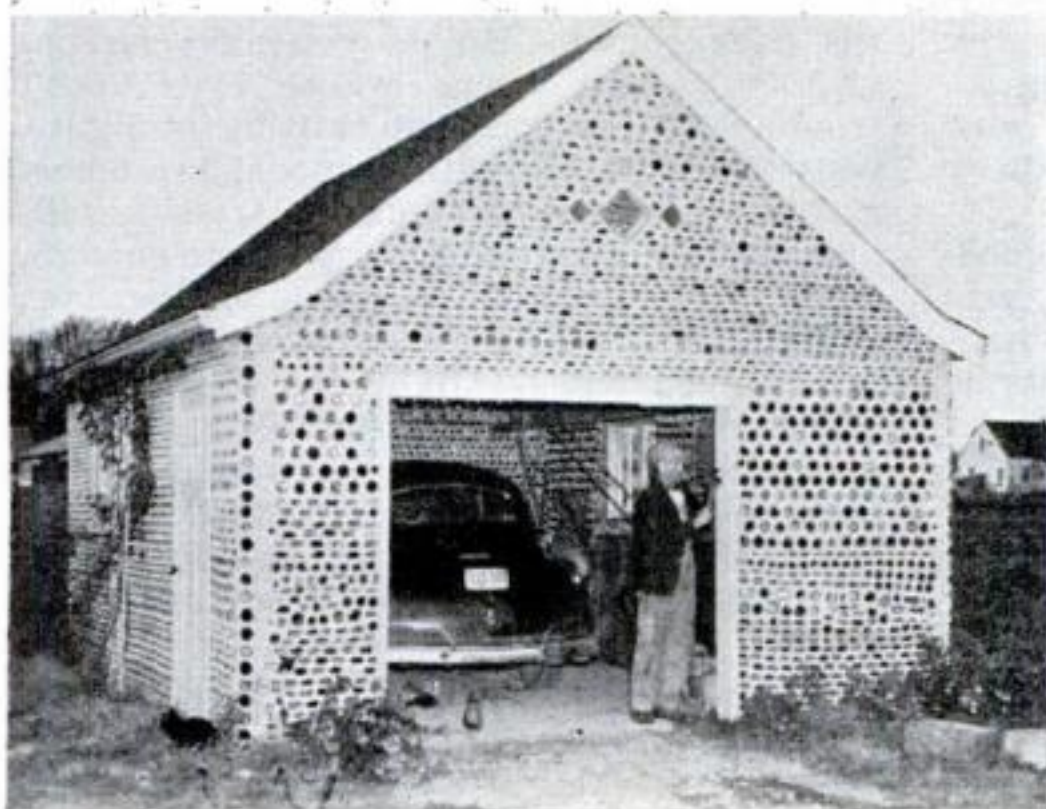
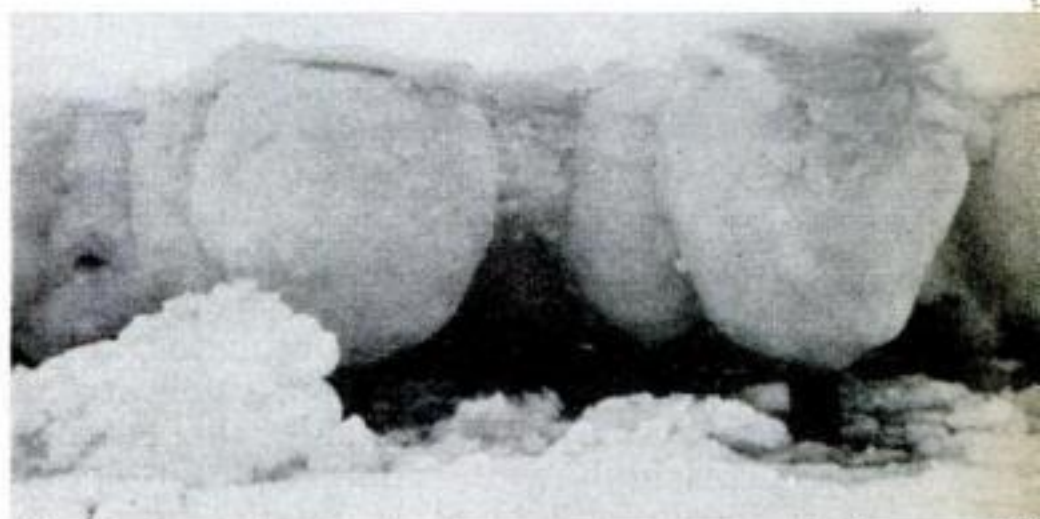
CAN YOU BEAT THESE PICTURES?

We will pay \$5 for any photo used on this page. Write your name and address on each print. Enclose a stamped, self-addressed envelope and the negative, if it is available, and send your contribution to the Curious Photos Editor.

NO SOLAR PHENOMENON, these rings on the Boston courthouse. They are the result of focusing the camera through the Army's famous ring sight that picks up moving targets accurately. Rainbow rings, produced by light through a lens in the sight, are projected so that they appear to be superimposed on the target.



MEAT IS SCARCE when it is sold in a bank. The signs in the window are no trick photography. A meat market had moved into a bank building in Newark, Ohio, when Harry Leeper, visiting from Canton in the same state, spotted it with his camera.



ICED PIERS that once held an old mill in Bath, Maine, made the odd photo above. With each rise and fall of the tide in winter, more ice is left on the piers until they look like this. Jean MacDonald, of Bath, took the picture.

ANY OLD BOTTLES? Neil Cornwall, a tinsmith, of Vienna, Va., saved a lot of them to build this garage. The bottles were laid in cement mortar like bricks after the framework had been put up. This interesting construction took two years—to collect bottles, not build.



Who Says

Hardly noticeable in his hand, the stub of a cigar helped this man to relax and to assume a characteristic expression. The background is not as plain as desirable, but a large lens aperture threw it out of focus just enough to make it unobtrusive.

sistent wonders in portraiture.

Well, now that you know, there is no reason why you can't take up portraiture with assurance of success. It's as simple as that. But it does take practice and planning and the memorizing of a few easy rules. There will be discouragements at first, but don't give up. You have before you one of the most fascinating and challenging phases of the whole fascinating, challenging field of photography.

Remember, to get expression that reveals character and personality, you must take your subject's mind off having his picture made. It helps immeasurably if you handle your camera and lights automatically. So practice, practice with the camera unloaded, going over and over the picture-making

process until you do every step without thinking. Practice focusing, practice composing in the finder or on the ground glass, setting the aperture, working the shutter, winding the film or pulling the slide, checking, and double-checking. Do it over and over again.

Practice arranging your lights to see how the shadows fall and how much light reaches the background. Unless you have an unusually patient friend whose eyes aren't troubled by the constant shifting of lights, you can do better with a model head borrowed or bought secondhand from a millinery shop. Two floods or spots are enough, but if you have a third, use it on the hair. With no artificial lighting at all, you can utilize good window light and a cardboard reflector. Strive for contrast between background and subject, with more light on one than the other, so the tones won't merge. Then work out several fairly standard light placements that you like and memorize them.

When practice has perfected your tech-

By FRANCES C. SMITH

ALMOST every amateur photographer has experienced taking at least one grab-bag portrait shot that turned out surprisingly well. And too often he has been encouraged by it to plunge into portraiture with enthusiasm before he even knew what made that one shot good. The result, in most cases, has been almost disastrous, with Aunt Susan demanding to know what he did to her nose and with Cousin George offended by a rogues' gallery rendering.

Here's what made that one portrait good. By a fortunate coincidence the lighting was just right, the background was not obtrusive, and the shutter was clicked at just the right moment to get a characteristic expression on the face of the subject. The photo thus achieved the two main objectives of portraiture. It was a pleasing likeness and it revealed character and personality. If he had only known, the amateur might have gone ahead to the working of con-

Portraits Are Difficult?

nique, you will be ready to tackle your first subject. After you have chosen him or her, do some deliberate planning. Think about him and try to decide, if you don't know already, his dominant trait or quality or the impression you want to bring out. Plan a series of poses and expressions that will bring out this trait, with or without props. Your shots may include only head and shoulders, or they may be three-quarter or full length. They may be formal or informal. Study the physical structure of your subject's face.

Plan a series of angles and lighting schemes that will subordinate such blemishes as a large nose, a prominent chin, or an extremely thin face, and will emphasize the best points, for a pleasing likeness is one of your aims.

With your plan in mind, you are ready to start on your portrait. Set up your equipment — seat, tripod, camera, and lights — before calling your subject into the room. Save a few last-minute adjustments until after he has been seated, for these sometimes serve to help take his mind off himself. Often an explanation of the photographic procedure will relieve his self-consciousness, or you might try discussing the movies, current happenings, sports, or anything in which he is interested. Some-

times a prop, like a cigarette or a book in his hand, will make him feel less stiff and posed even if it doesn't show in the finished picture.

Meanwhile, make a quick last-minute check of details such as a stray lamp shade or corner of a framed picture that might spoil the background, a crooked tie or collar, or a disorderly lock of hair.

And now you are ready to click the shutter the instant you get the expression you want on your subject's face. Often this can be achieved with a simple trick, such as asking him to smile but not to hold the smile. Make the exposure just at the end of the smile when his face is still relaxed. Other



No one need be told that everything is right in one of these photos and everything wrong in the other. At left, stiffness, bad nose lighting, collar awry, and cluttered background. Above, the same subject in a real portrait.

old stand-bys are remarks such as, "Don't look so serious. This is painless, you know—not like the dentist's." One photographer used to ask soldiers for a "furlough expression." This invariably drew an eager, "I wish I had a furlough!" The moment the lips stopped moving and before the sparkle was lost, the shutter was snapped.

One old trick that relaxes facial muscles and adds good high lights is to get the sitter, especially a woman, to moisten the lips. Click the shutter the instant the lips are still again. Try it yourself and feel how tenseness around your mouth is relaxed.

That's all except for a few rules. They might be stated this way:

Keep lighting simple. Use only 45-deg. lighting at first. There will be plenty of time later to be as daring as you wish.

Take your time. Warn your subjects at the start that picture-making is a slow process, and let nothing hurry you into a bad shot.

Have a simple background. It should be plain or at least undistracting. Seat the subject far enough in front of it to avoid



Taken with an ordinary box camera, this character-study of a girl shows that it's the photographer, rather than costly equipment, that is the crucial ingredient in picture quality. One simple trick is employed to add life to the photo at left—body and head are turned at slightly different angles.



shadows. A plain wall or unpatterned blanket will do. If you have neither, a large aperture will throw the background out of focus.

Most people look best with the face in a three-quarter pose, but there are variations. A thin face looks fuller from the front; a fat one is narrowed by a slight turn. Noses can often be straightened by taking them at just the right angle. Body and face turned in slightly different directions adds life. A high camera angle helps double chins, jowls, and long necks—but not bald heads.

If you can't get his face relaxed, take your subject smiling.

Diffuse the lights with tissue paper if your camera has an extremely sharp lens. This softens facial lines without retouching. For extreme diffusion, fasten cellophane over the camera lens with a rubber band.

Take plenty of exposures. The right expression is fleeting. Tastes differ, too, and what you like may not please your subject. Give him as many pictures as possible.

TRY GRANDPA'S CAMERA

THERE'RE PICTURES IN THE OLD BOX YET

TUCKED away in attics, pawnshops, and the store-rooms of photographic-supply firms are cameras long considered junk but still capable of taking good pictures. Such were the three old-timers shown here.

The 4" by 5" Eastman box is dated about 1885. I cut the box in half and mounted on it the plate back from an old 4" by 5" German Mentor press reflex. Used with high-speed cut film and a No. 20 photoflash bulb on "open" flash, its lens is amply fast for posed shots in dark interiors. The lens has remarkable depth and cuts sharply to the corners. Stopping down is done with the primitive Waterhouse diaphragm, and the shutter, an old "guillotine" type, is set by pulling up on a catgut string.

Having a lens of rather long focus, the 3¼" by 4¼" Pony Premo B makes fine portraits. Its iris diaphragm, U. S. aperture markings, and listed shutter speeds from 1 to 1/100 second date it at about 1900. The 4" by 5" plate camera of the nineties with a



double - extension bellows and tilt back has proved valuable in copying and in picturing small objects. For good definition I mounted on it a modern Zeiss f/4.5 lens in place of its old rapid-rectilinear one.

Many old cameras have double - extension bellows and a rising front, and some also have a tilt back. Lens boards are easily removed

for substitution of another objective. A portrait attachment can be used on some old lenses to achieve a wider angle.

In buying an old camera, check every detail. Look for excessive sag and broken corners in the bellows and for warp in the frame, listen to the release at each shutter speed, and open and close the diaphragm. Examine each plate holder and slide for breaks and warping; then put each holder into the camera and pull it out again to determine whether the frame is sprung.

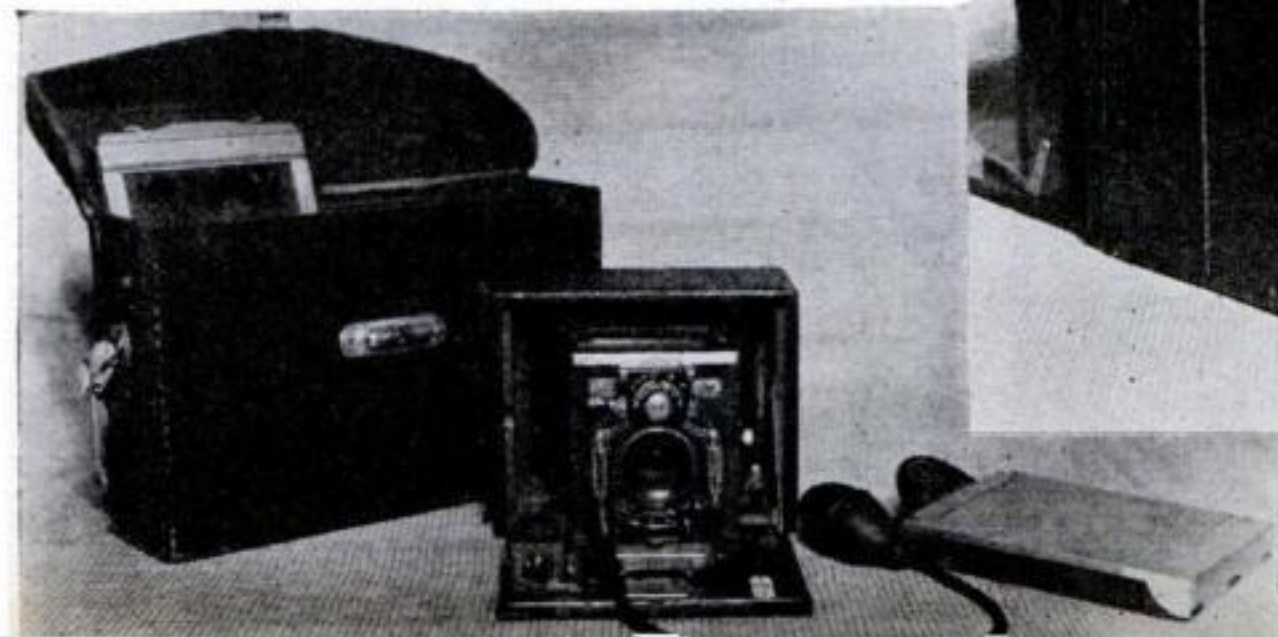
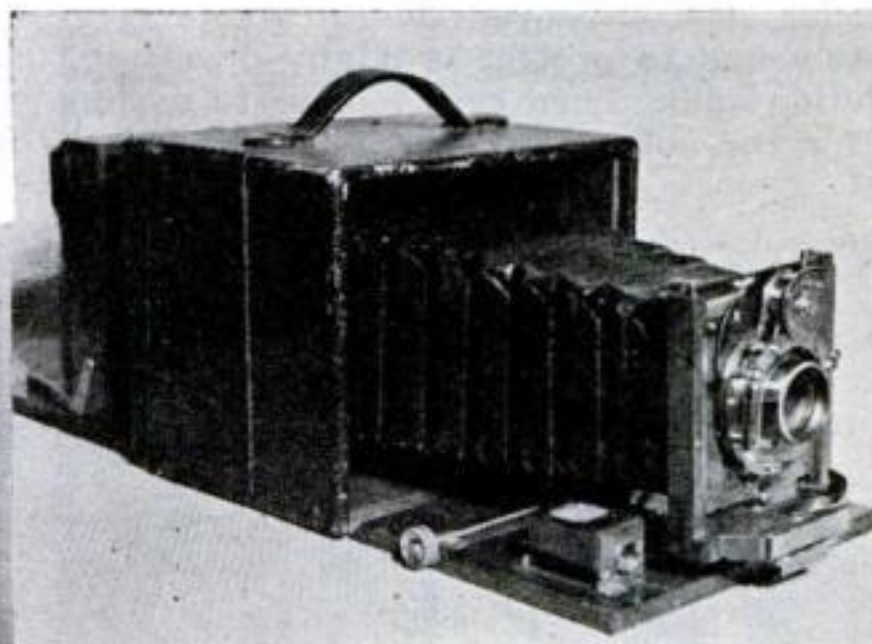
When you get home, open every holder, wipe it out thoroughly with a cloth, scrub with a dry, stiff brush, and tap it against the palm of your hand. Clean the bellows and the rest of the camera inside and out with a cloth, and rub a little light oil or dressing into the leather. Do not oil the shutter mechanism. Clean the lens carefully with lens tissue. Check the bellows for pinholes in a strong light, shielding your eyes and the camera interior with a black cloth. Holes can be patched with adhesive tape.

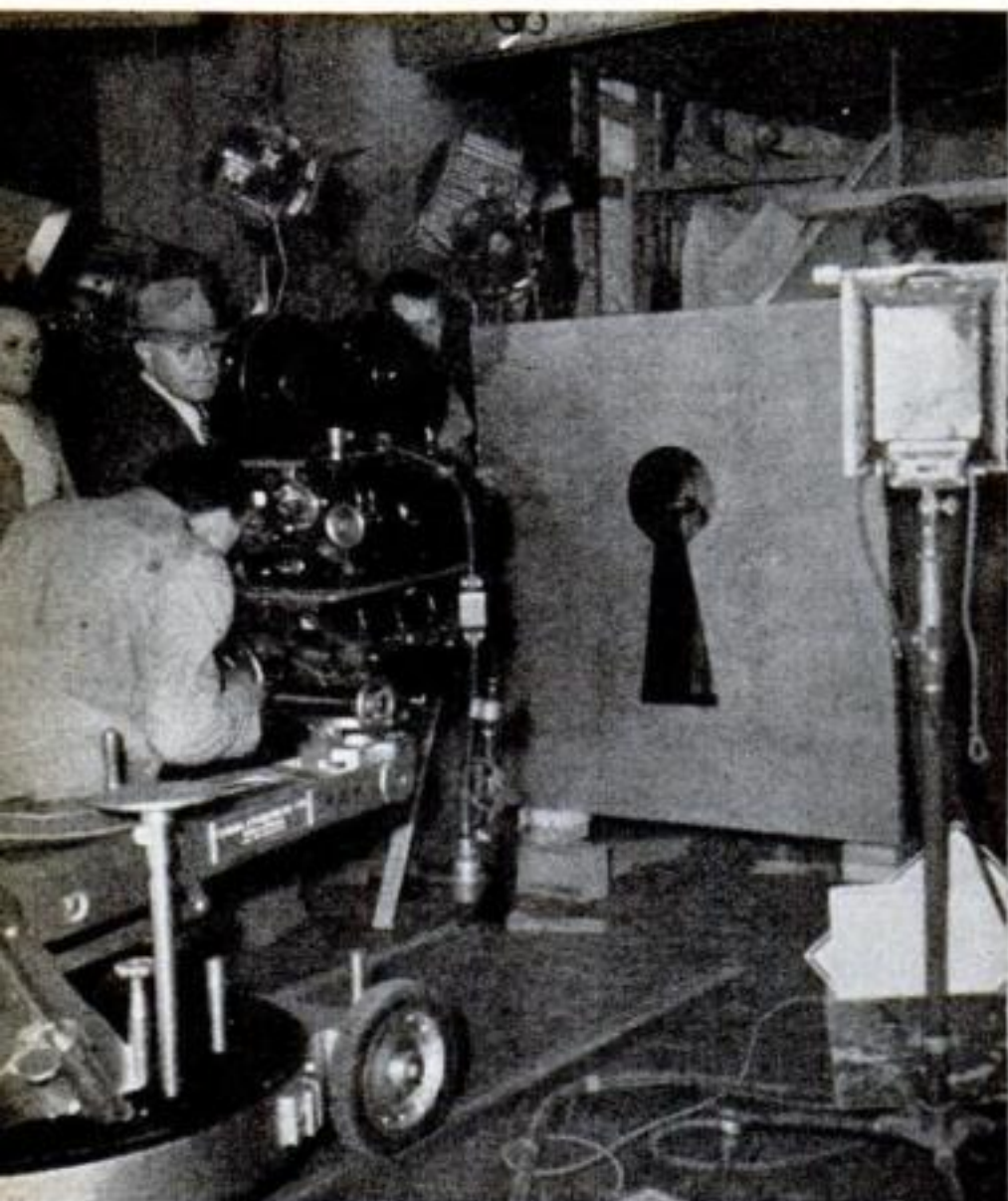
Most old lever releases are stiff and inclined to jar, so it is advisable to use a rubber bulb. I believe that, because of gumming and wear, shutter speeds may be slower than indicated.—CHARLES BARR.



Used with modern, fast cut film, the 1885 Eastman box at left makes good pictures. A button pull draws up its guillotine shutter.

Excellent portraits are taken with the long-focus lens of the Pony Premo B shown below. The job at right has a double-extension bellows, a tilting back, and a rising-falling front.



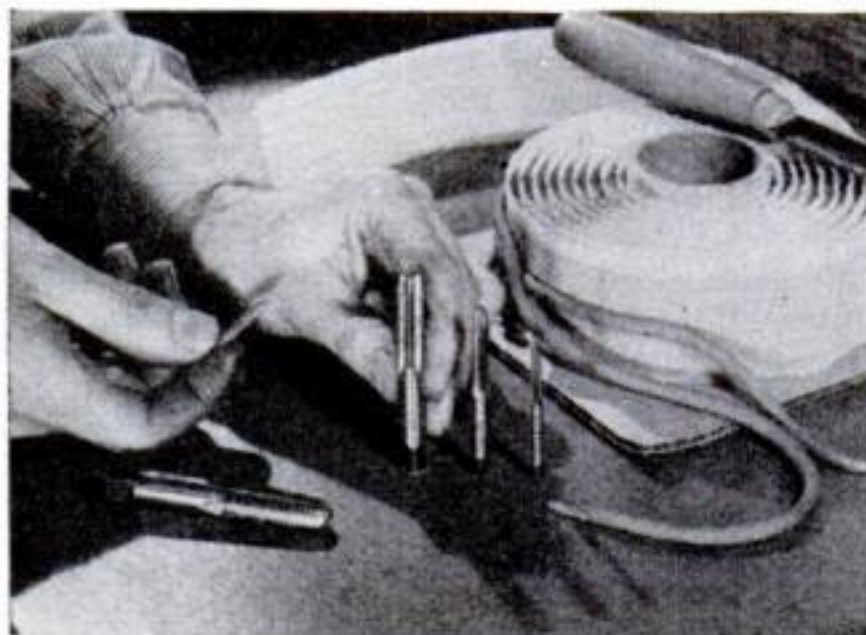


KEYHOLE VIEWS are taken by Hollywood cameramen through an actual keyhole—but it's a giant-size affair like that above. Similar comedy and decorative masks make unusual borders for home movies as well as for professional films. They can be cut quickly from large sheets of cardboard.

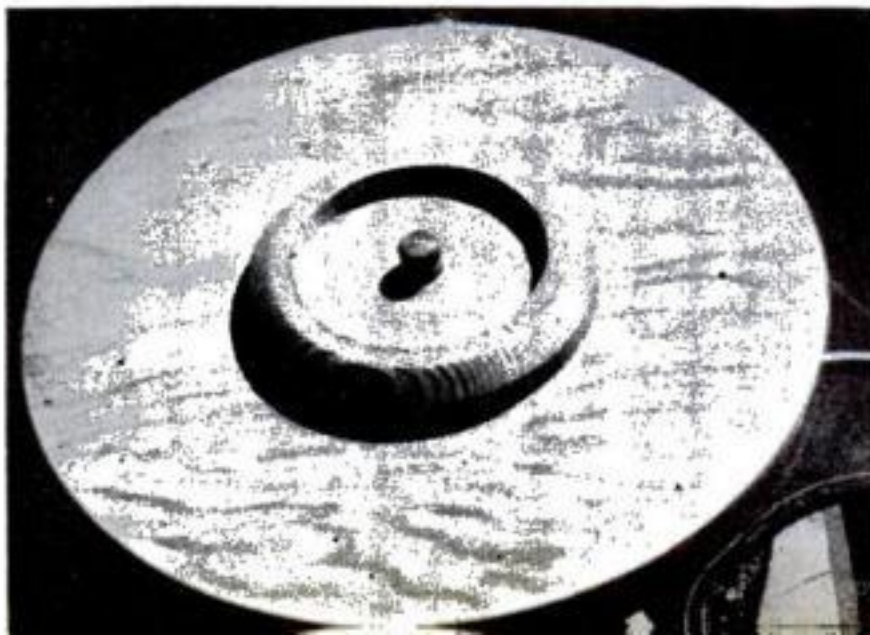
LARGE GLASS JARS for mixing photographic solutions can be premarked at the level of the final solution with a rubber band stretched around the circumference. Water poured in from a graduate serves as the initial guide. Several bands can be cemented on permanently, or lines may be marked with waterproof paint.—JAMES P. SAUNDERS.

PHONOGRAPH TURNTABLES are efficient agitators for developing tanks. Cut a wooden disk to cover the turntable completely and to protect it if any developing solution spill. Then turn a base to a snug fit for the bottom of your developing tank

SMALL OBJECTS to be photographed can be made to stand upright by sticking them to a table with small pieces of ropelike calking compound available in hardware stores. The material will secure light objects to sloping or vertical surfaces. Molded into tiny rods or other forms, it also permits you to support pieces above a surface for taking exploded views of mechanisms. The compound sticks well and can be removed without leaving a mark.—W. E. B.



and glue or nail it to the wooden disk as indicated in the photos below. If the bottom of the base is given a slight slope before being glued on, it will keep the tank from turning too smoothly and will assure complete agitation of the liquid.—SIDNEY POTT.



TAXES have nothing on this trick, right, that makes money disappear without a trace. Put a dime in the center of a handkerchief and fold the edges over the coin. Catching the corners and the coin, lift the handkerchief aloft. For the benefit of your skeptical audience, let someone feel the coin through the handkerchief to make sure it's still there. Now, shake the hanky loose. Nothing falls out! Not surprising, either, if you've done the trick right. Using a handkerchief with a wide hem, rip out a few stitches in one corner and sew a dime into the pocket thus formed. When you lift the handkerchief, drop the loose dime in your lap. Your friends feel the concealed one.



TAKE A MATCH BOX from your pocket and open the drawer. What you see inside seems to surprise you and you can pass the surprise on to your friends by reaching into the box and pulling out a full-length pencil. How? By concealing the pencil in your left coat sleeve and cutting out the back of the box.



TABLE TRICKS

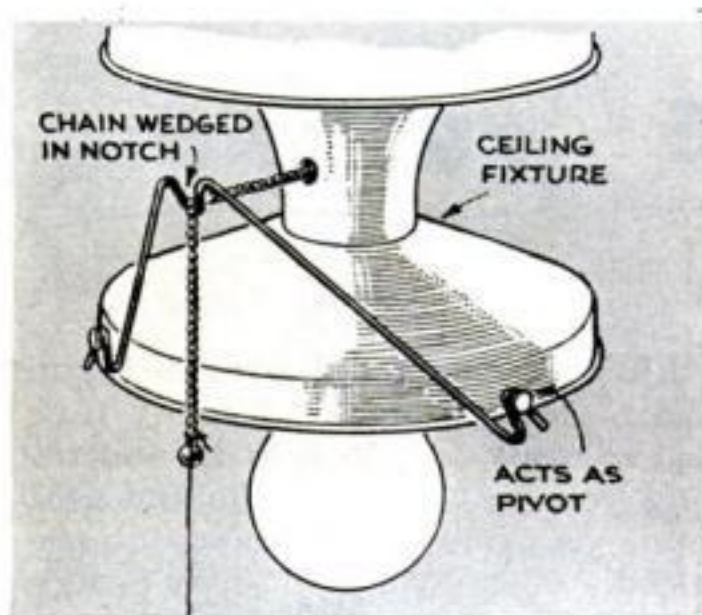
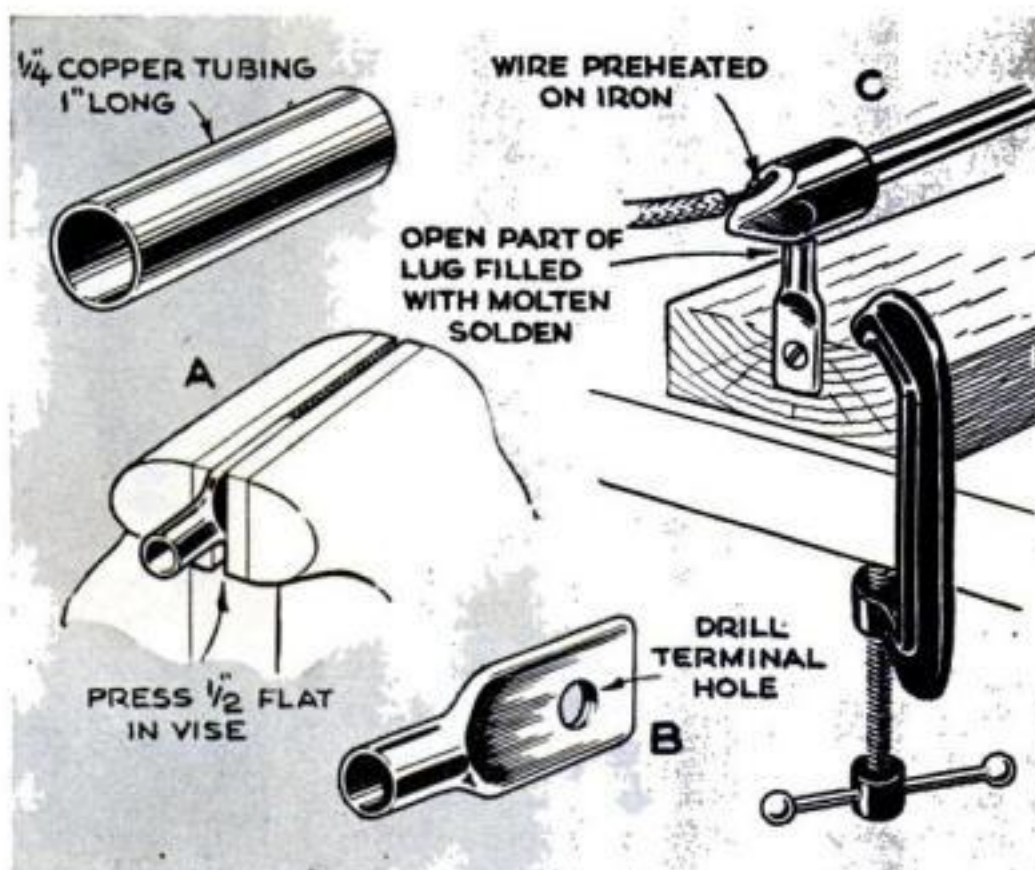
THE EYE IS QUICKER than the hand provided you know what to look for. Hold a deck of cards face down and ask a friend to draw one, look at it, and replace it without letting you see. Then shuffle and deal the cards out one by one, as below, till you come to the one he picked. You need a deck with a one-way design on the back, arranged in advance so the cards all face the same way. Turn the pack so that the right card is replaced the wrong way.



SAND DOESN'T GET WET even though it is dumped into a bowl of water and stirred thoroughly. To prove it, do just that. Then scoop the sand out slowly and it will be as dry as when you put it in. It won't work, of course, unless you have previously heated the sand together with a very small amount of paraffin wax. When cold, the treated sand will repel water effectively, and the paraffin coating won't be noticed.

Oversize Soldering Lugs Made of Copper Tubing

SOLDERING-LUG terminals capable of handling heavy currents may be speedily fashioned from odd scraps of $\frac{1}{4}$ " copper tubing. Saw off a piece about 1" long and flatten it for half its length in a vise. File corners round and drill the center hole; then clean the inside of the tubing with a scrap of emery cloth wrapped around a nail. For convenience in attaching the lug, screw it to a block of wood. After filling the open part of the lug with molten solder, preheat the wire and insert it quickly while the solder is still fluid.—F. R.



Pull-Chain Swivel Bracket Smooths Operation of Ceiling Light Fixtures

LIGHTING fixtures often become sluggish in operation because the chain drags or scrapes against the frame and the return spring becomes too weak. When this happens—or to prevent it from happening—bend a length of coat-hanger wire as shown so that the apex of the curve forms a cradle for the chain. Hook the wire arms tightly over the screw heads in the lower lip of the fixture. The wire arm not only prevents the chain from snagging, but it helps it to spring back.—G. HAMLIN LEONARD.

Spring Block Acts as Temporary Terminal

ELECTRICAL experimenters often have need for a terminal block to join wires temporarily while testing or hooking up circuits. Usually this is done by twisting the bared ends of the wire together, but in many ways it is more convenient and safer to use a terminal block.

Mount a short piece of spring wire—preferably bronze or brass—to a nonconducting base by means of two small angle pieces. To make contact, press the bared ends of the wires through the turns of the spring, but be sure the current is off first.—HAROLD P. STRAND.



Sandpaper Nail Files Used to Clean Small Motor Commutator



ROUGH commutator surfaces sometimes cause otherwise perfect motors to spark badly and operate far below normal speed. Most often, to be sure, these symptoms can be traced to badly worn brushes, but if these are not at fault, hold a sandboard against the commutator while running the motor at lowest speed. Smoothing the rough edges should immediately improve the efficiency of the motor.—A. E. SCHIEVE.



Modified drill presses, fitted with lapping plates, are used to reduce quartz chips to approximate size.

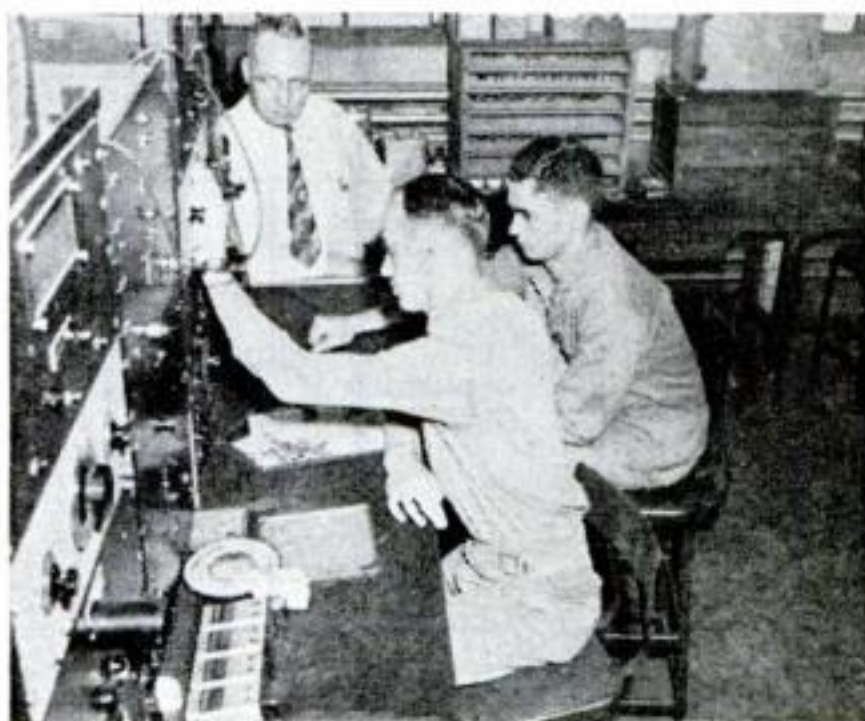


To obtain accurate frequency control, every crystal must be finished by hand (above), and tested on an oscillator (below). If it can then pass heat, shock, and vibration tests, the crystal is ready for use.

Army Crystal-Grinding School Trains Sailors and Marines

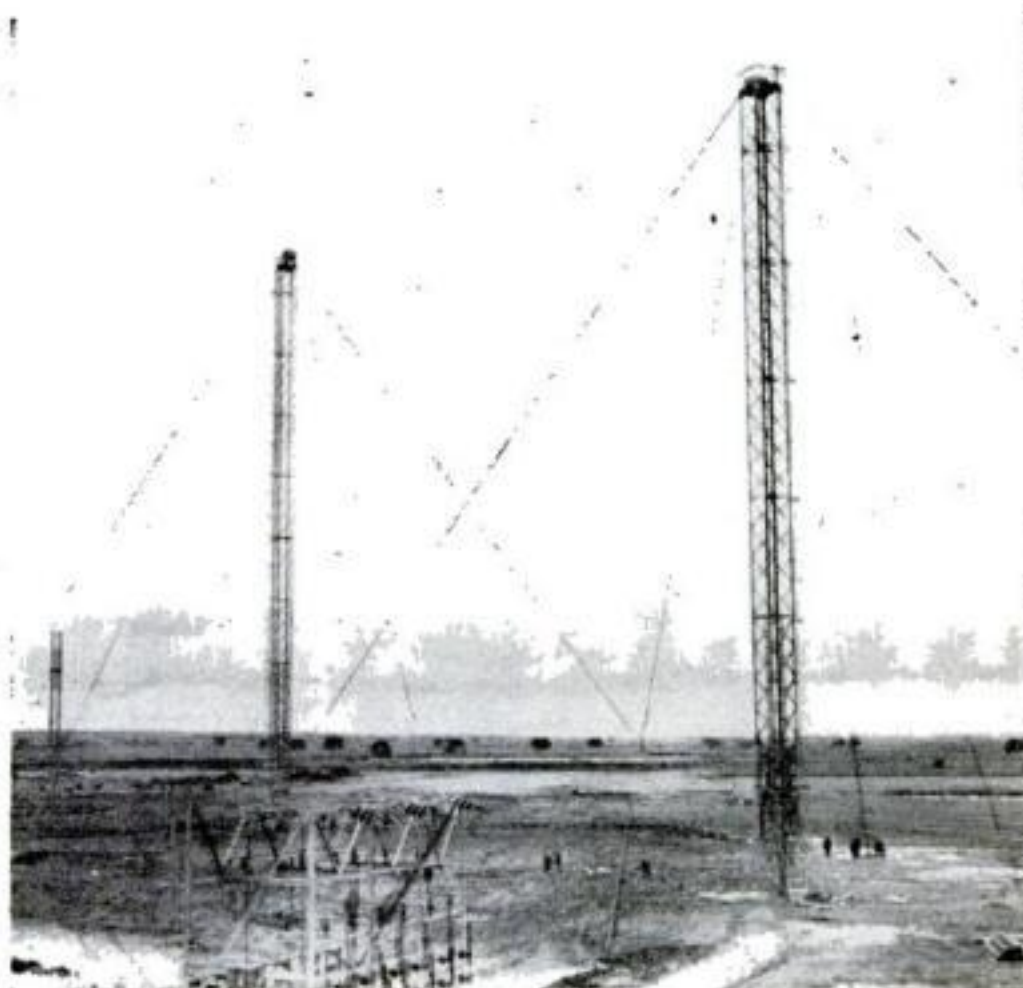
PAPER-THIN quartz crystals, which have helped maintain military communications under the most difficult battle conditions, must be finished to within one ten-thousandth of an inch of specification—definitely not a job for amateurs. Even slight errors would affect the frequency to be selected.

The Army's only school for crystal craftsmen, a part of the Holabird Signal Depot, at Baltimore, is attended also by Navy and Marine Corps personnel. After an eight-week course, trained technicians are sent into the field to process the frequency-controlling oscillator plates used in practically all service radios.



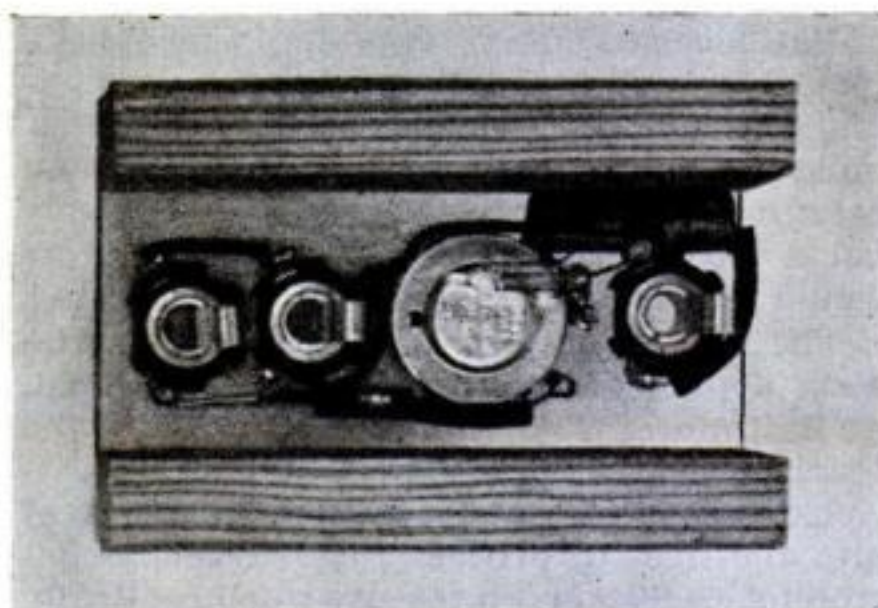
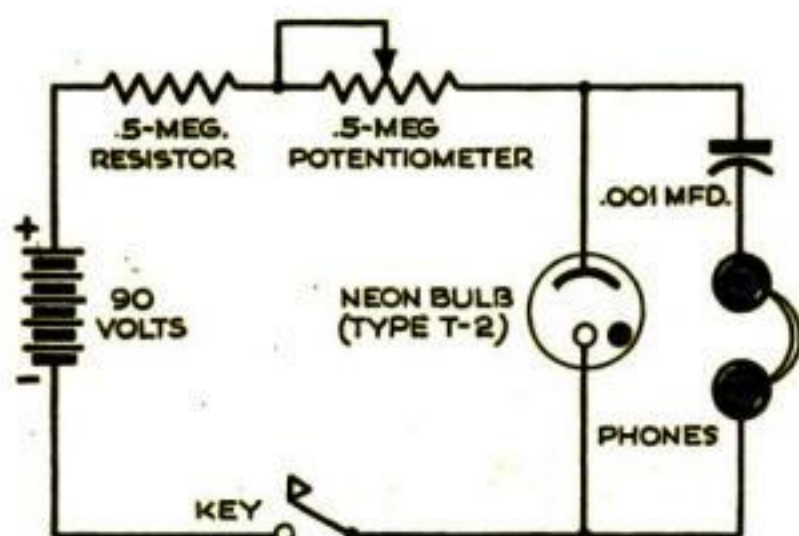
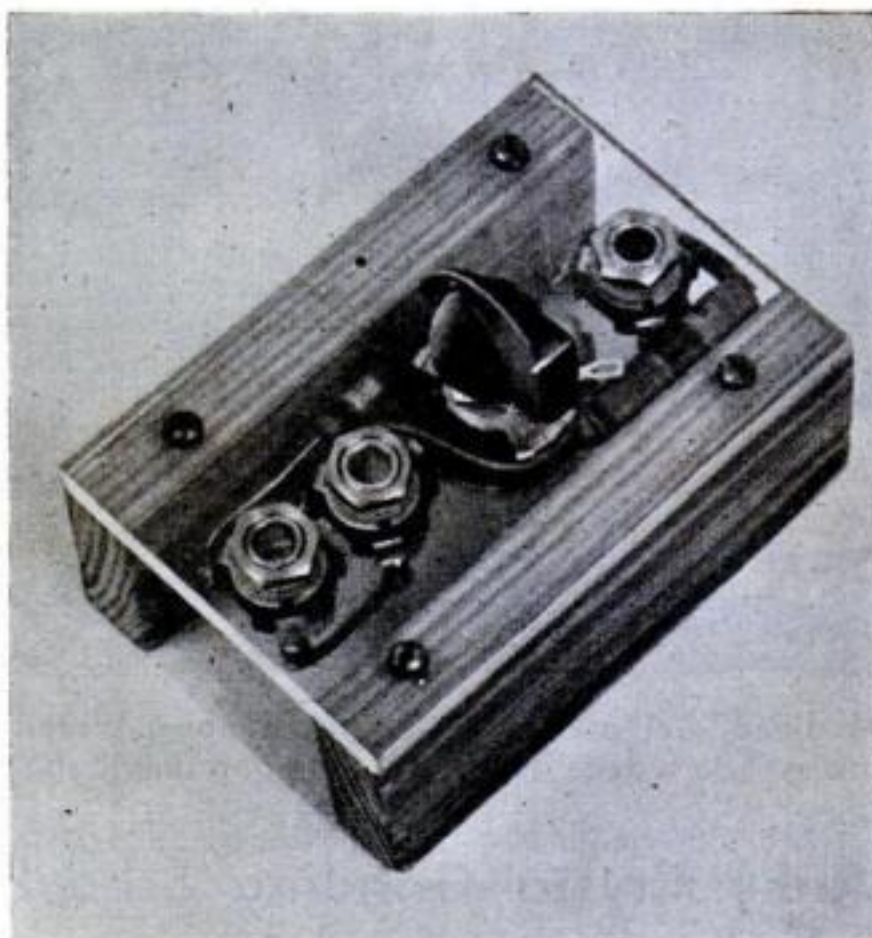
New Canadian Station Broadcasts to World

ONE of the most powerful short-wave stations in America has been placed in operation to beam programs all over the world. The site of the station, a salt marshland at Sackville, New Brunswick, Canada, has proved doubly advantageous; the marsh acts as an "electric mirror" that augments signal strength, and the location is one of the few in Canada uninfluenced by the north magnetic pole. The station boasts a highly directional beam antenna, pictured at the right, that is said to multiply effective output many times. More than 26 miles of wire are used for the antennas, connected to towers varying in height from 170' to 380'.



Relaxation Oscillator Makes Portable Code Practice Set

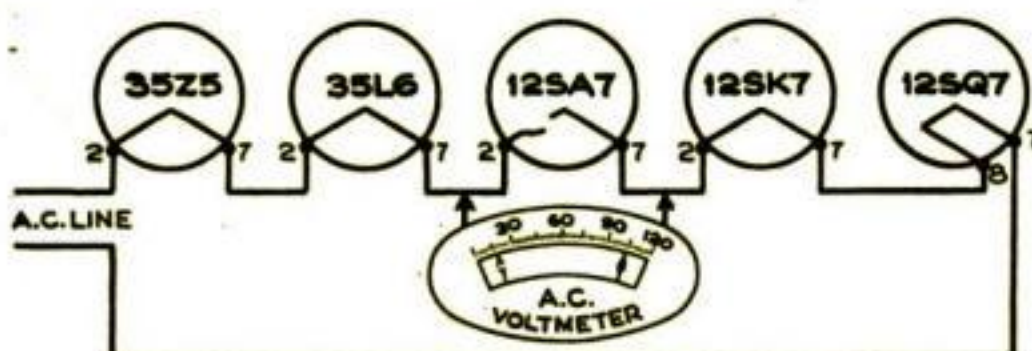
LEARNING the dot-and-dash alphabet is only a preliminary step in code mastery, for the knack of fast operation really depends upon getting acquainted with the sound of the incoming signal. This compact practice oscillator has the advantage of being adjustable through a variety of sound frequencies and tones. The capacity of the condenser connected in series with the headphones determines the fundamental frequency of the oscillator; if a higher pitch is wanted, it may be necessary to use a smaller condenser. Some tone control can also be obtained by adjusting the potentiometer. Many types of small neon tubes will work satisfactorily in this circuit. A miniature 90-volt B battery can be used safely as the current drain is slight.—WALTER F. POWELL, JR.



Home Test Gives Quick Check on Burned-Out Tube Filaments

BURNED-OUT tube filaments account for a great percentage of radio failures and are worth looking for when a radio goes dead. When filaments are connected in parallel, allow the set to cool, turn it on, and touch all the tubes. If you find one that stays cool, you're hot.

In an A.C.-D.C., series-wired radio, none of the tubes will light, but an A.C. voltmeter will point out the guilty one when held across each pair of heater terminals. The meter completes the circuit and



gives a reading of about 110 volts. If the filament should close during the test, the voltage will drop to its normal value for the tube.—G. BOLTON.

High-Temperature Solder Found to Shorten Life of Fine Wire

MOLTEN solders have been found to reduce the diameter of copper wire and cause some embrittlement of the parts subjected to high temperatures. In tests conducted by engineers of the Fairchild Camera & Instru-

ment Corp., of New York, it was shown that destructiveness was greatest in fine wires and increased with the tin content of the solder. For delicate work, therefore, solders of low melting point should be used.

Trouble-Shooting A.C. Motors

By JONAS H. WOOD

MOTORS of less than 1 hp. are playing an increasingly important part in the home and workshop, and yet they get little or no attention until they begin to smoke or refuse to start. The average person feels

that he has done his part when he fills the cups with oil once in a while; and then, when a motor burns out, he gets a new one and promptly treats it in the same offhand way.

This may have been all right in the days when homes had few appliances; but now, with motors for oil burners, stokers, re-

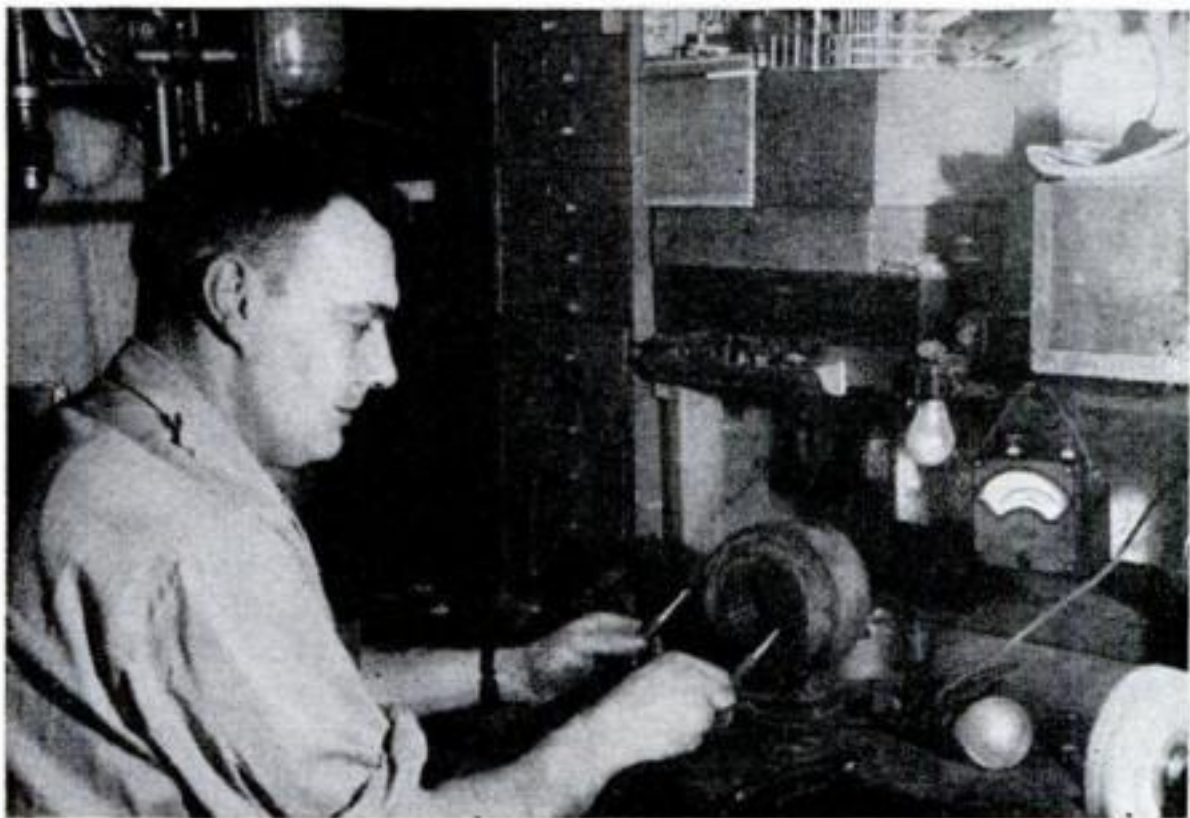
frigerators, washing machines, vacuum cleaners, sewing machines, food mixers, electric fans, movie projectors, and basement-workshop tools, systematic care pays off in protecting one's investment.

Proper oiling and cleaning are the best preventive maintenance. Never use too much oil and never oil too often. The manufacturer's advice, as set forth on the name plate or in an instruction booklet, should be followed. Motors having sleeve bearings and a packed wick need oiling only every 1,000 hours of use. Old-type motors having a removable reservoir at each end with a spring and wick bearing on the shaft should have their reservoirs kept filled with a good heavy oil. Ball bearings need occasional cleaning and repacking with new grease.

A clean motor is the best insurance against burning out. Look fairly often at the windings and switch, for 90 percent of all trouble starts with dirt and oil in one or the other. Use only carbon tetrachloride for cleaning, and don't use too much of that. When you have trouble in spite of precautions, the chart at the left will help.

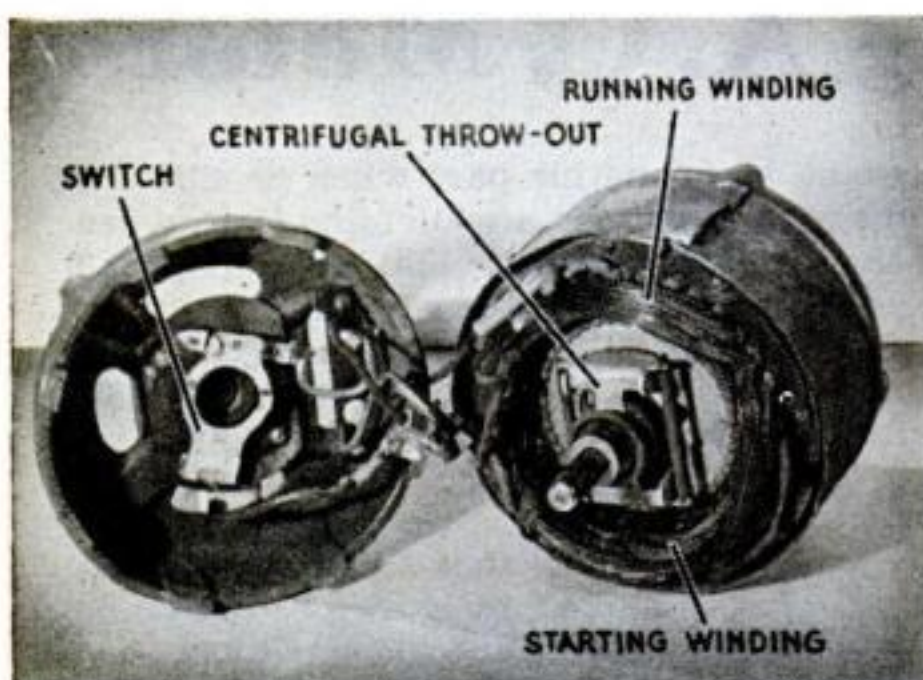
All appliance and home-workshop motors fall roughly into five main classes. Four are variants of the single-phase A.C. induction motor. The fifth is the universal motor designed for use on either A.C. or D.C. It is found in sewing machines, vacuum cleaners, food mixers, home-movie projectors, portable drills, saws, routers, and business machines.

Universal motors have a wound armature, two fixed brushes, and a higher speed than induction motors. It is

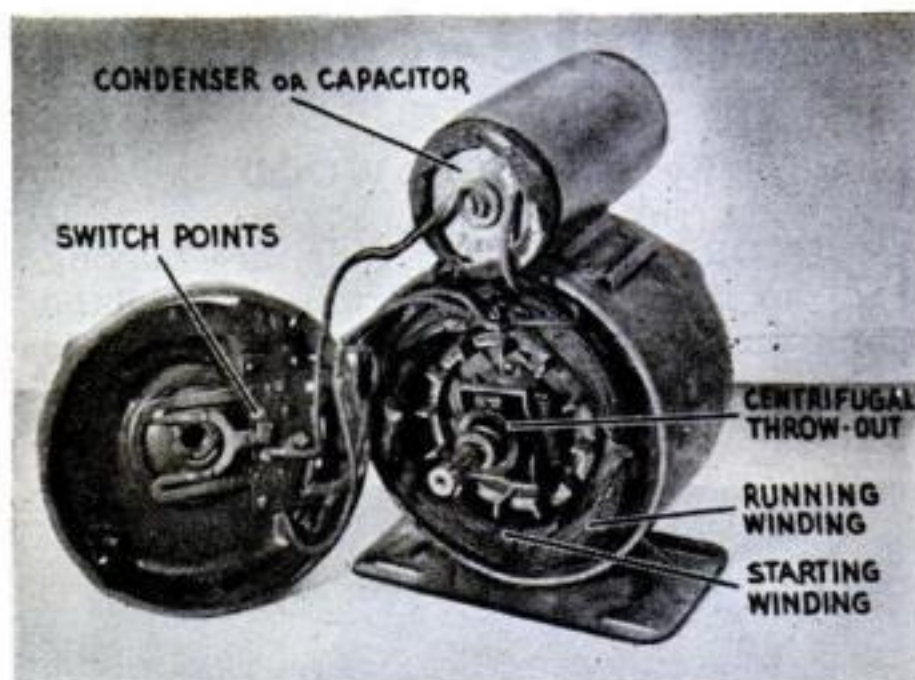


A little preventive maintenance will keep many a small motor going. The chart below will be of help in trouble-shooting.

MOTOR	TROUBLE	PROBABLE CAUSE	WHAT TO DO
Split-phase and split-phase condenser or capacitor	Will not start	Open circuit in line	Check current to motor leads
		Thermal overload out	Reset overload relay
	Hums, but will not run	Starting-switch points not closed	Clean starting switch
		Open circuit in running or starting winding	Check continuity with test light
		Defective condenser	Replace condenser
	Runs slowly and jerkily and heats rapidly	Starting-switch points not opening at proper time	Clean points; check centrifugal throw-out springs
		Bearings gummed	Clean with carbon tetrachloride; use fresh oil
		Broken or loose bars in rotor	Replace or tighten bars
Series (D.C. and universal types)	Will not start	Open circuit in line	Check current to motor leads
		Brushes not making contact with commutator	Check brush springs and replace worn brushes
		Open circuit in field coils	Check for continuity with test light
	Runs slowly and overheats rapidly with excessive sparking at brushes	Dirty or scored commutator	Clean with carbon tetrachloride and fine sandpaper. If badly grooved, turn down in lathe
		Shorted commutator bars or high mica	Clean between bars and undercut mica
		Shorted windings on armature	Rewind armature
		Repulsion-induction	Will not start
Brush yoke may be loose and shifted to neutral point	Move yoke to right or left and tighten setscrews		
Hums, but will not run	Brushes not making contact with commutator		Check spring tension on brush holders; replace worn brushes
Runs, but will not come up to speed; overheats rapidly	Shorting device not in contact		Check centrifugal throw-out
	Shorting necklace broken		Replace necklace



Split-phase motor.



Split-phase capacitor motor.

wise to examine the brushes occasionally and to replace them before they wear down to the springs and begin to score the commutator.

Single-phase A.C. induction motors exert no turning force with a single winding and must use a secondary stator winding or wound armature to obtain the revolving magnetic field necessary for a start. As speed reaches 70 or 80 percent of normal, this auxiliary or false second phase is cut out, and the motor then operates on single phase.

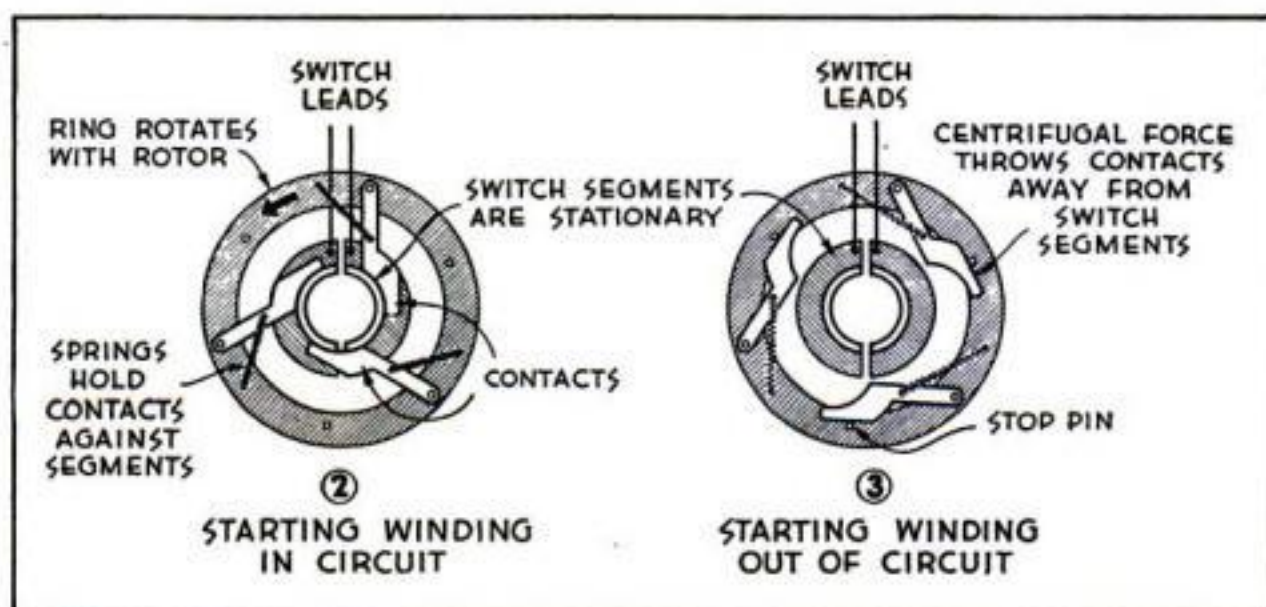
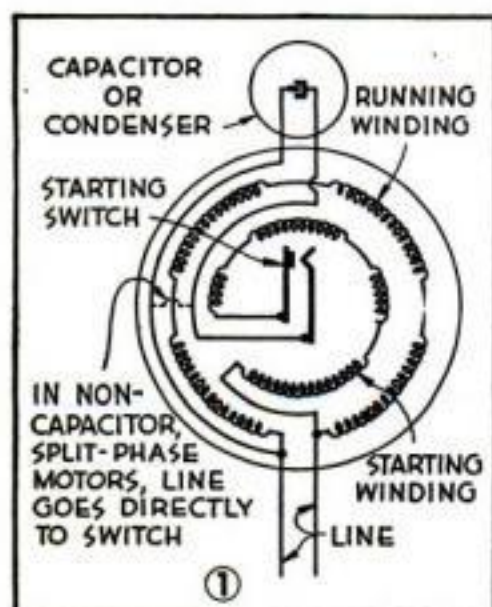
Most of the motors in common use are of the single-phase induction type known as split-phase motors. They are equipped with an auxiliary winding that is displaced in magnetic position from the main winding and connected in parallel with it. These motors are found on machines with light starting loads, such as washing machines, churns, bottle washers, some business machines, oil burners, blowers, centrifugal pumps, phonographs, woodworking tools, grinders, and other machine tools.

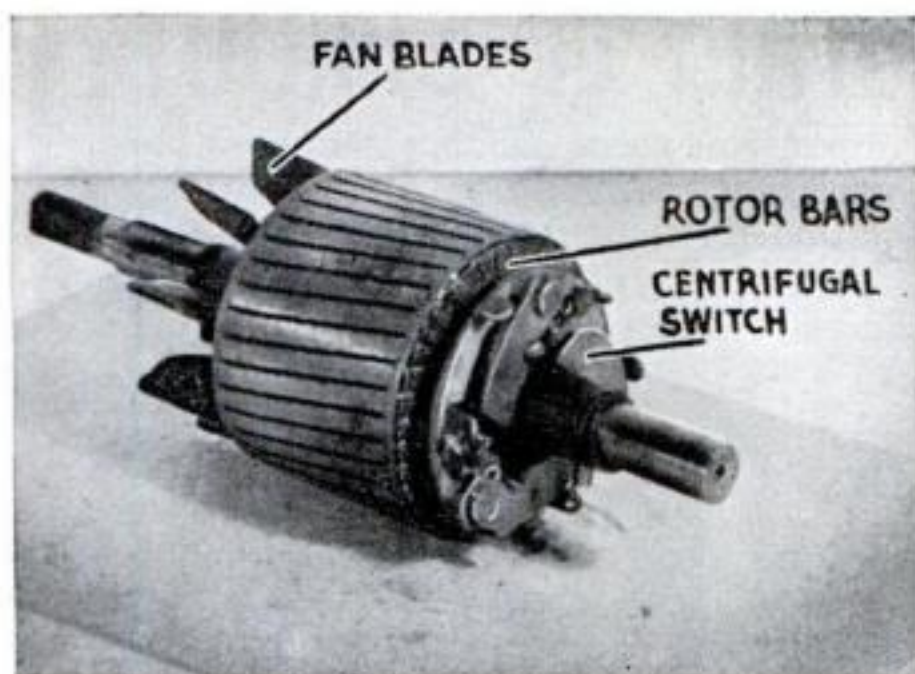
Split-phase motors can be recognized by their solid rotor, two separate stator windings, and a centrifugally operated switch for cutting out the starting winding at proper speed. This switch is a focal point for trouble since all the dust, lint, and shavings drawn in by the internal fan collect at this point

on any excess oil that might be thrown by the shaft. As the switch opens, the arc sometimes sets the debris on fire and burns out the motor.

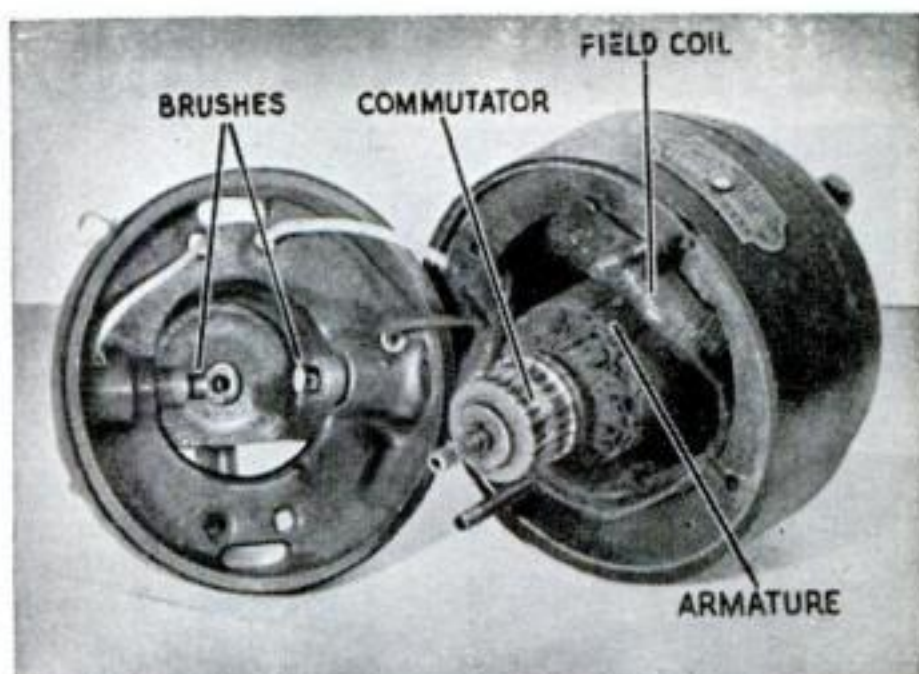
The capacitor or condenser motor has a round or square can, usually mounted on the top or side of the motor frame and containing the condenser or capacitor component. Some have a doughnut-shaped condenser inside the motor case. They have two windings and centrifugal cutout switches. Their use is on appliances like refrigerators, pumps, and stokers with fairly heavy starting loads. It is good practice to remove the end bells occasionally and blow out dirt and grease from the switch and windings.

Repulsion-induction motors are used for the heaviest starting loads, such as water pumps, air compressors, and some of the older refrigerators. They are characterized by a wound armature similar to a D.C. motor and two or four brushes mounted on a movable brush yoke. All have a device for short-circuiting the commutator bars as the motor comes up to speed. Governor weights on the front end of the armature in one type push through the core to bring the shorting necklace in contact with the rotor bars and to lift the brushes from the commutator face. In the brush-riding variant, the shorting device is pressed against the bars by centrifugal force while the brushes remain





Rotor from a split-phase motor.



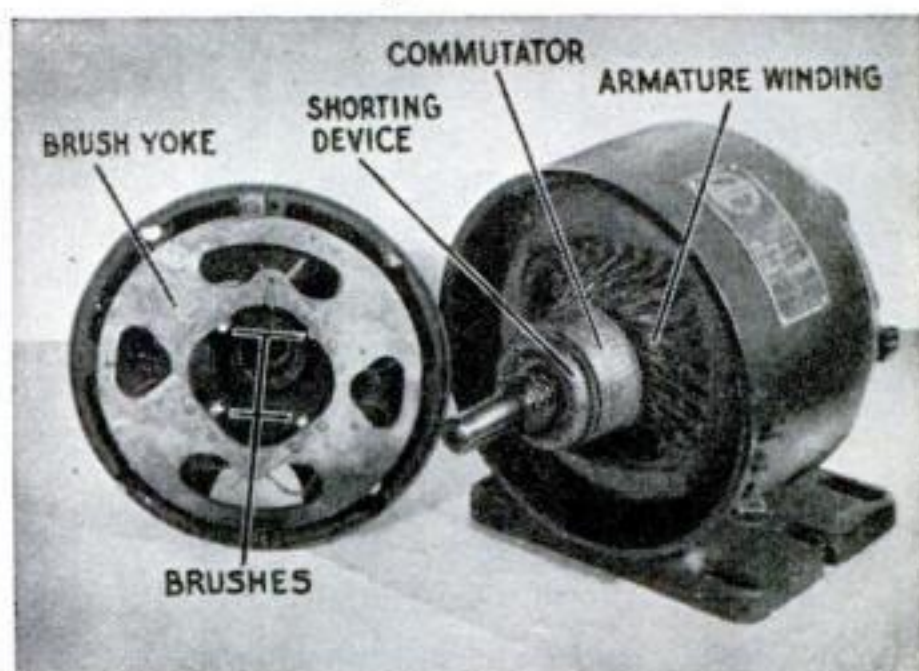
Series-type blower motor.

in contact. Trouble can usually be traced to dirt, oil, or a broken necklace in this starting mechanism.

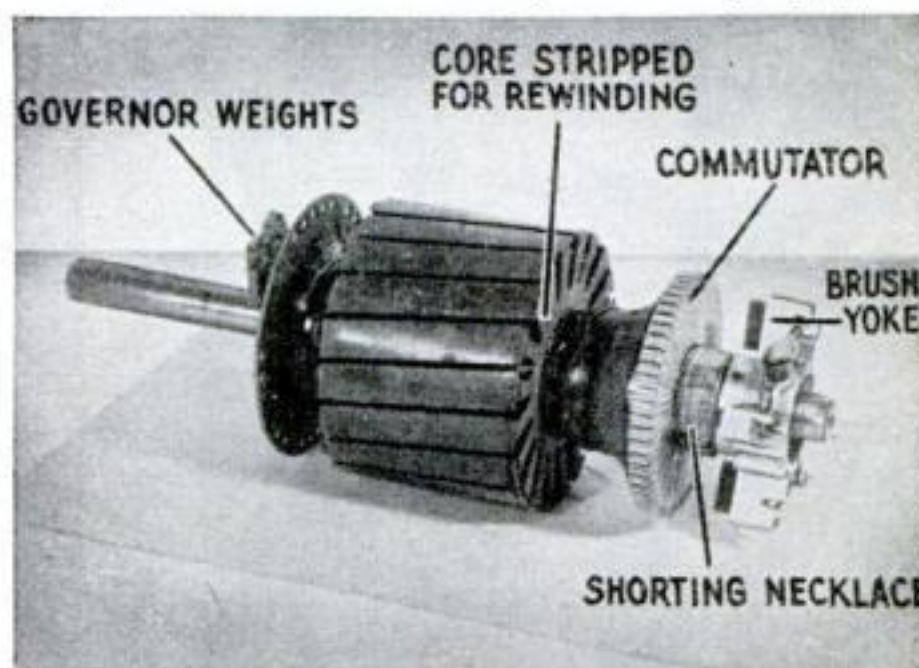
Shaded-pole motors are the type usually found on fans and small appliances having a light starting torque. This fourth variant of the single-phase A.C. induction motor is a small motor with copper rings set in slots in the stator to assist in starting. There is no commutator, switch, or slip ring, and the shaft is the only moving part. Such motors are rugged and reliable, but on a heavy load, or if the bearings are gummed, they will stall quickly and may burn out if the current isn't cut. Because little can go wrong, they are omitted from the check list. Nothing is required in the way of maintenance except cleaning and oiling.

On heavy duty or where a motor may be loaded beyond its rating, try your hand frequently on the housing to test for overheating. A rise of 50 deg. C. is usually safe during operation. Name-plate information generally gives permissible temperature rise.

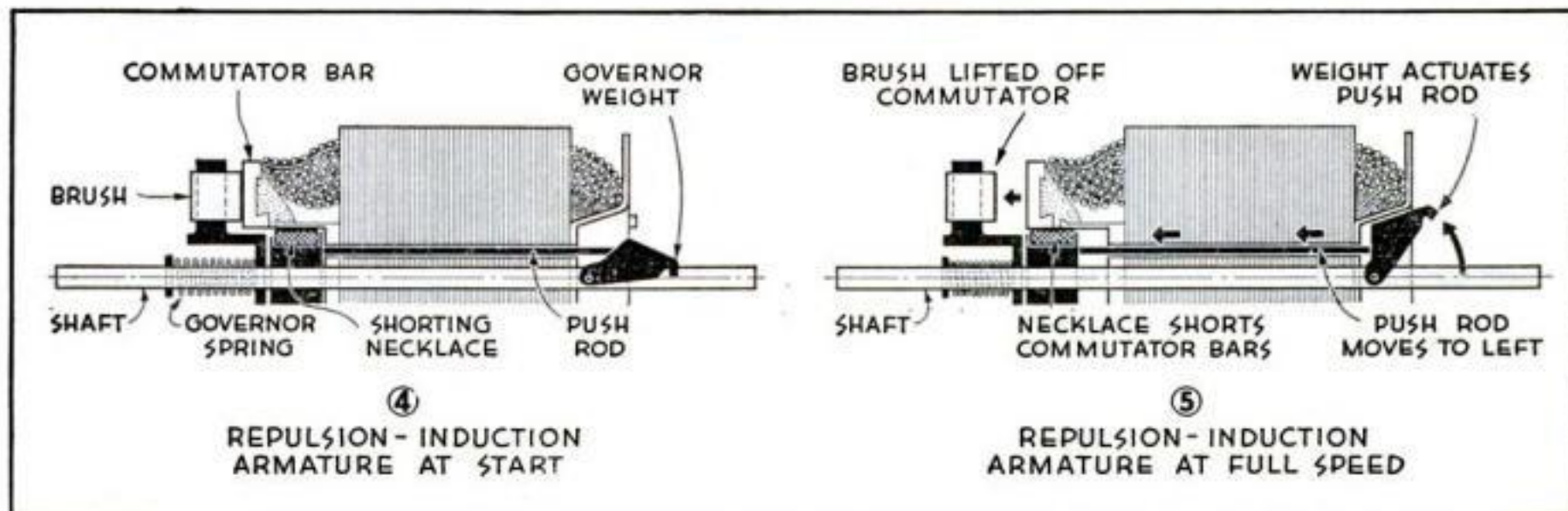
Once in a while, depending on how much the motor is run, check on the brushes, holders, and shunts, and clean the motor with compressed air. Grease should be cleaned out of ball and roller bearings and replaced every year or two.



Repulsion-induction motor (brush-riding type).



Repulsion-induction armature (brush-lifting type).



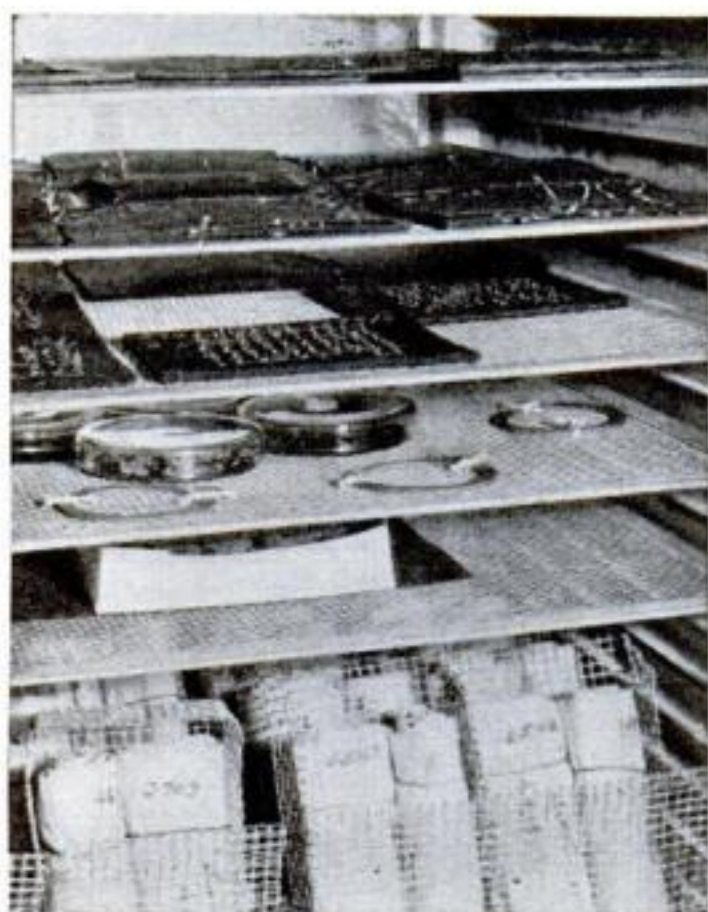
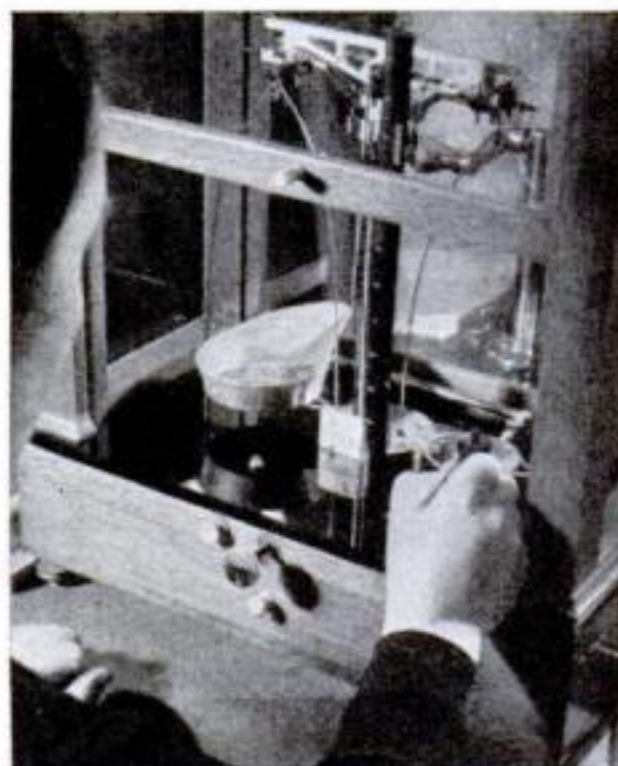
HOW DO YOU KNOW THEY'LL SPROUT?



WHEN your flower seeds produce a ragged yield, you have plenty of reason to be sore. But that's poor consolation for a farmer or Victory gardener who has lost a season's crop. Germination tests take the guesswork out of planting.

Preparing for a test at the seed laboratory of New Hampshire University. The sample is first thoroughly mixed in the machine, left, that resembles an old-style coffee grinder.

In order to forecast the size of the crop that may be expected from a given batch of seed, it is necessary to know the exact size of the specimens being tested. At the right, samples are weighed.



With the aid of a magnifying lens and a pair of tweezers, pure seed is separated from inert matter, other plants, and weeds. The resulting percentage is a guide to quality.

Germination tests are made by placing seeds on damp blotting paper, as shown at the left, center.

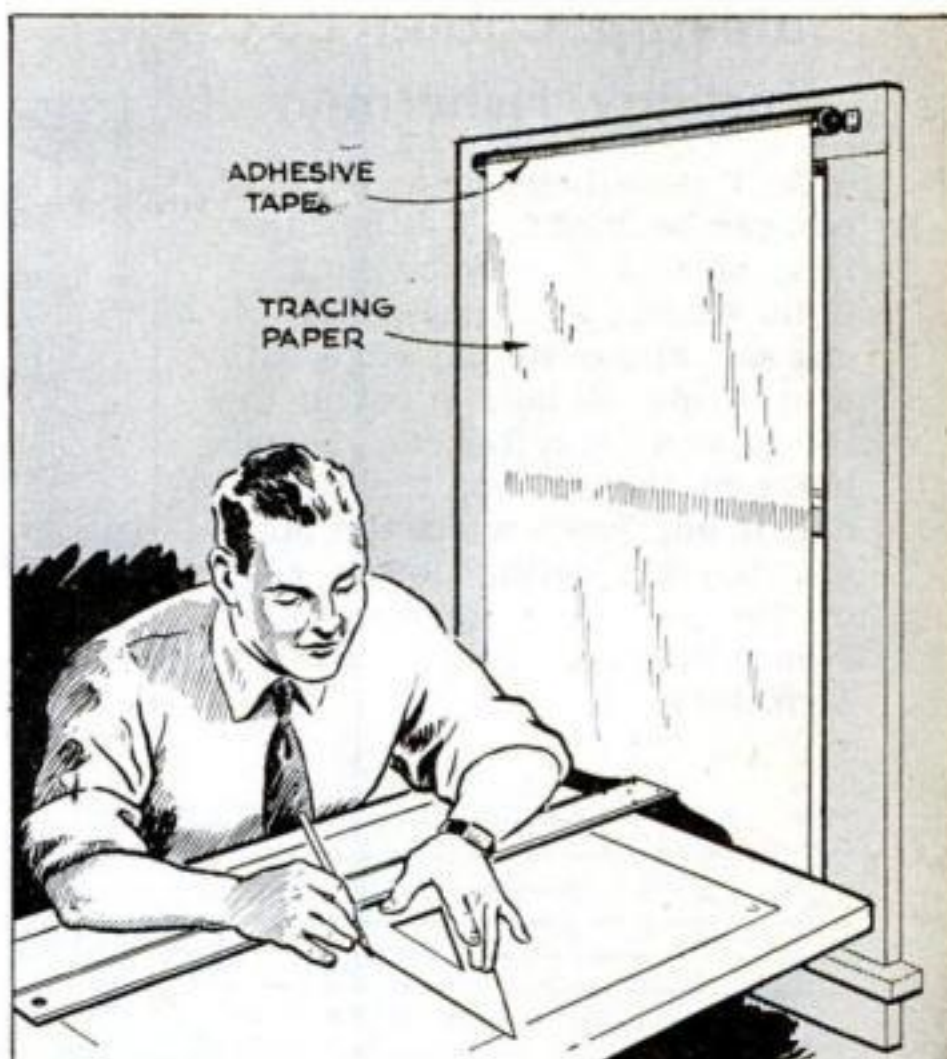
Germinated seed, left, ready to be counted. The mold-like fuzz is the root system. Time and temperature of all tests must be rigidly controlled. Percentage of germination is determined by hand-counting the sprouts, as at right.



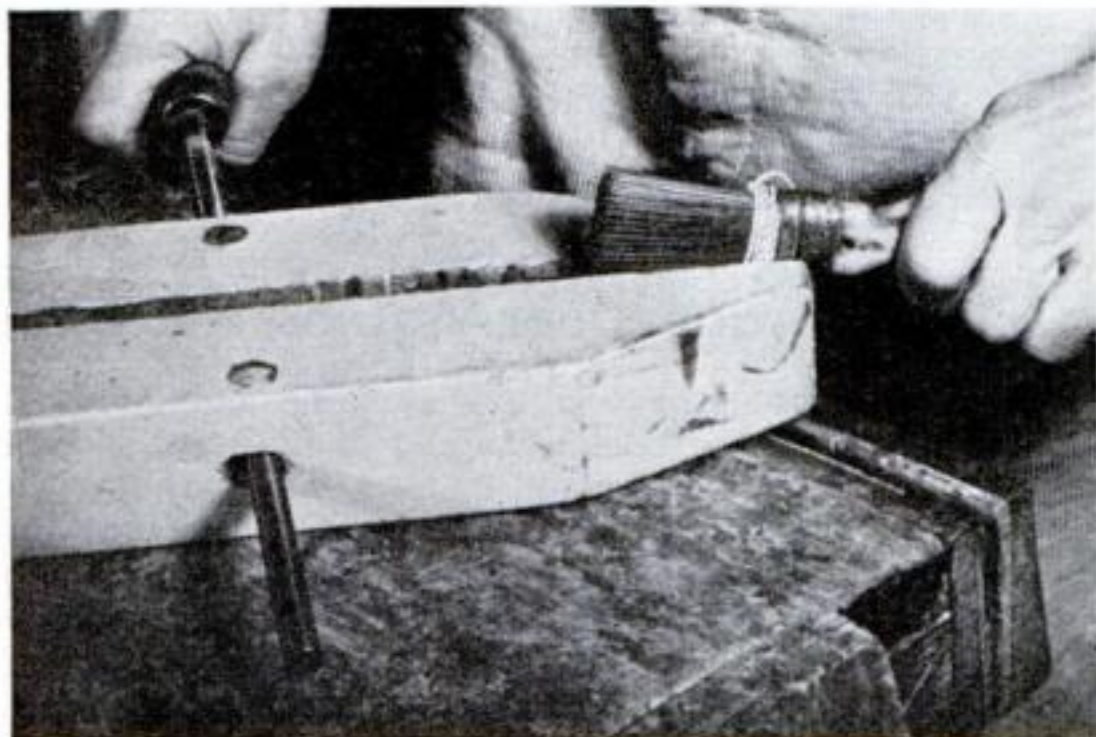
Tracing-Paper Window Shade Takes Glare Out of Sunlight

IF YOU are bothered by glare from a window adjacent to your drawing board or other work table or bench, you can find the remedy in a large sheet of draftsman's tracing paper. Remove the original shade from its spring roller, and substitute for it a sheet of tracing paper as wide as the window and a few inches longer. Ordinary shades darken a room when drawn, but the tracing paper will admit an evenly diffused, soft light that is easy to work by.

The tracing paper may be attached to the roller with cement or adhesive tape, or the end may be folded down $\frac{1}{2}$ " and cemented and tacked. For a stiff bottom edge, fold up $1\frac{1}{2}$ " or 2" and cement it around a thin wood strip. Insert a screw eye and attach a pull cord. If properly attached the tracing paper can be rolled up and down like a shade, but a little extra care is required to avoid creasing or tearing the sheet.—H. DROUYN.



Clamp Pressure Realigns Bristles of Reclaimed Paintbrush



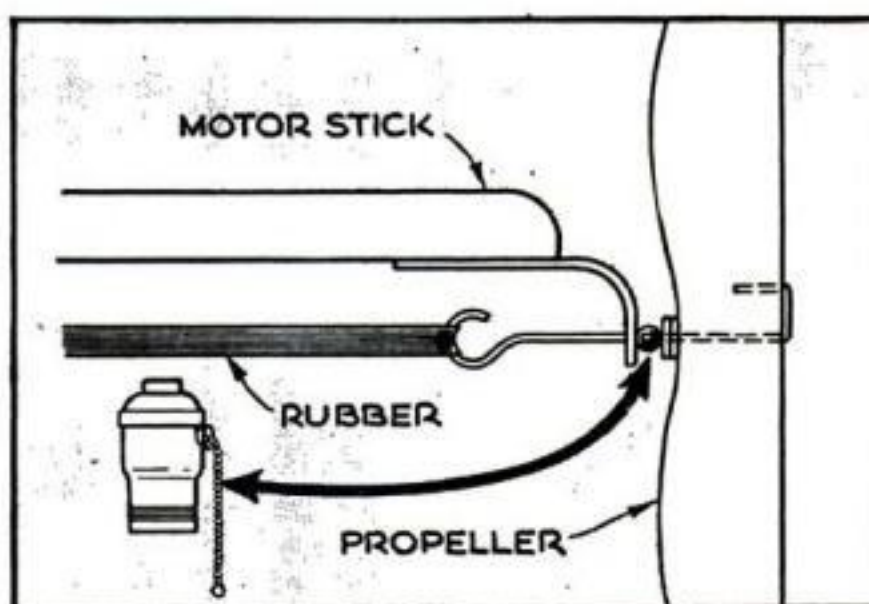
ONE great fault with reconditioned paintbrushes is the bushiness of the bristles caused by dried paint at the roots. No matter how hard you work, some dried paint stays.

This can be corrected with a $\frac{3}{8}$ " wrapping of heavy twine starting at the ferrule. Wrap the twine tightly, tie it firmly, and then squeeze the base of the bristles in a clamp. Let the brush dry thoroughly and shape it carefully. Pressure flattens the bristles to almost normal thickness, and the twine prevents bulging edges.—E. M. L.

Bearing for Model Plane from Electric-Light Pull Chain

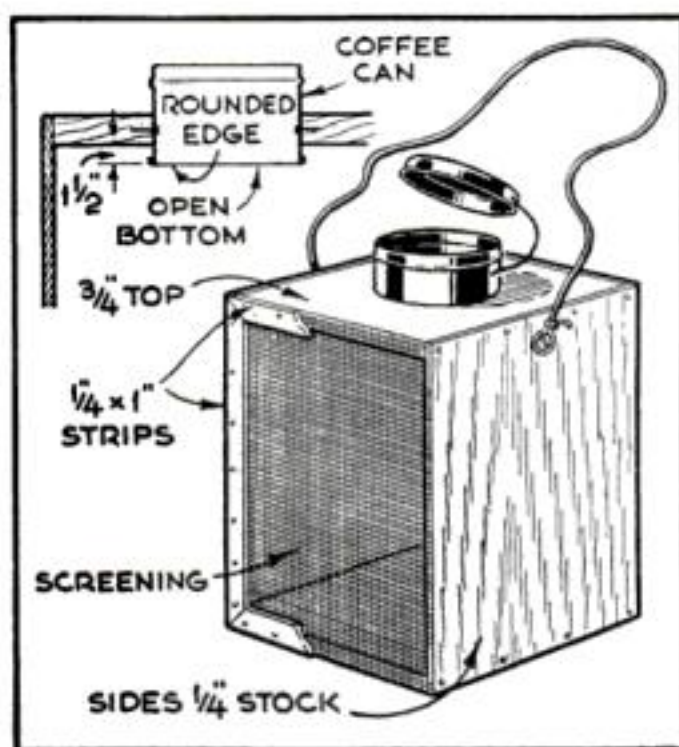
A SINGLE brass ball clipped from an electric-light pull chain will substitute for a glass bead as a propeller bearing on a model plane. It already has the necessary center hole and will create little friction between the washer and the steel motor mount.

In cutting off the ball, take care not to let the small nub of protruding wire slip back into the cut. Grasp the wire with the pliers and pull it out; then smooth the ball with emery cloth. If you have trouble keeping the wire nub from getting lost inside the ball, cut off two balls together and pull them apart.—ALFRED G. MILLS.



Safe-Top Cricket Box for Boy Fishermen

ANY small wooden packing box can be used for this bait carrier, or a box may be built of light stock. Tack screening on one side and cover the edge with thin strips. A hole is cut in the top to fit a tin coffee can. Punch holes in the side of the can to nail it on. Even when the lid is off, the projecting lower edge of the can will keep crickets from jumping out. — FREDDY MITCHELL.



Runway from Porch Gives Pets Access to Pen

CATS and other small pets can go outside for sunning whenever they wish, and yet be kept from annoying neighbors, with a runway leading to a pen from a rear porch. Provide an opening for the runway in the porch screen or lattice and another in the pen, and enclose both runway and pen with screening. Hinge the top of the pen so the inside can be cleaned.—H. LEEPER.

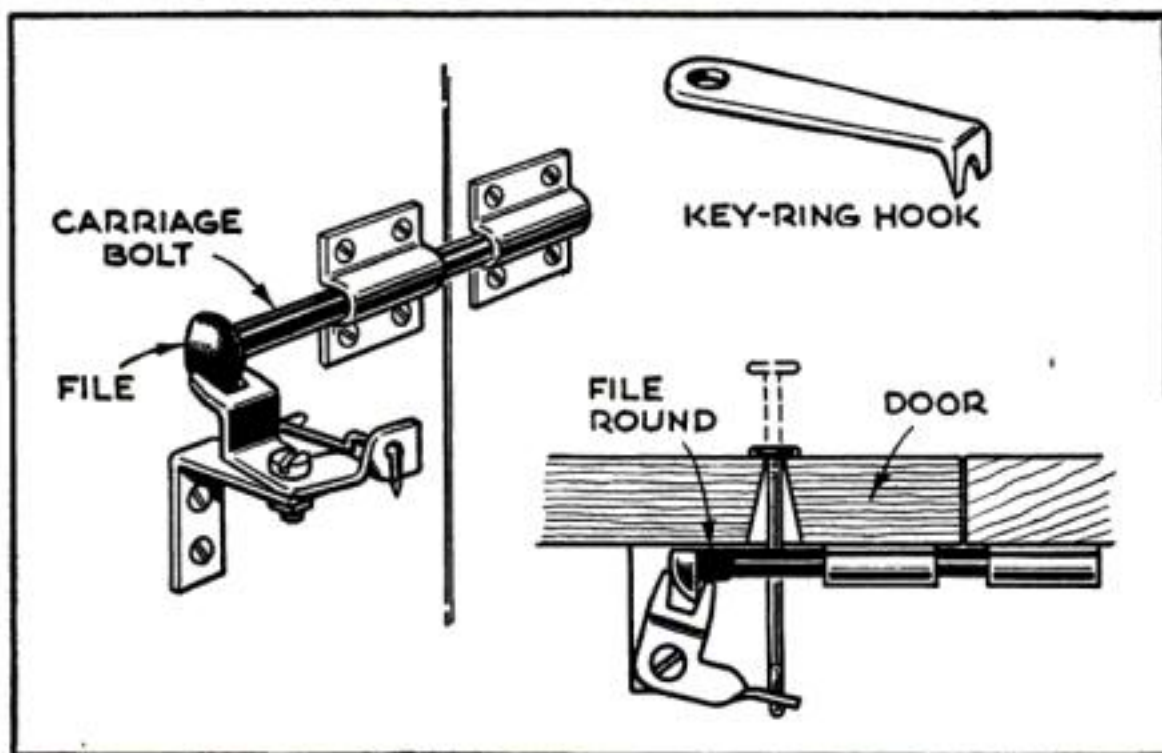
Camouflaged Barrel Bolt Locks Garage Door Against Prowlers

IF THE hardware shortage has left your tool-shed or garage door swinging in every breeze, bend a few metal brackets to the shapes shown below and shut the door on the vexing problem. The bolt is actuated by a nail with a head that looks exactly like the surrounding ones in the outside boards.

A carriage bolt used for the barrel bolt

passes through U-shaped brackets to lock the door. Bend the end of the nail, as indicated, and hook it to a pivoted piece of strap iron bent to form a bell crank. The bolt slides as the nail is pulled or pushed.

You can unbolt the door without a key, but a small nail puller on your key ring saves your fingernails.—P. B. HORSLEY.



HOME EXPERIMENTS SHOW SOME PROPERTIES OF LIGHT

CANDLE POWER means the luminous intensity of any light compared with that of a standard candle. A Joly photometer, an instrument for helping determine this comparative brightness, can be made by warming one face of each of two identical blocks of paraffin and pressing them together, like a sandwich, with a piece of tin foil of equal size between.

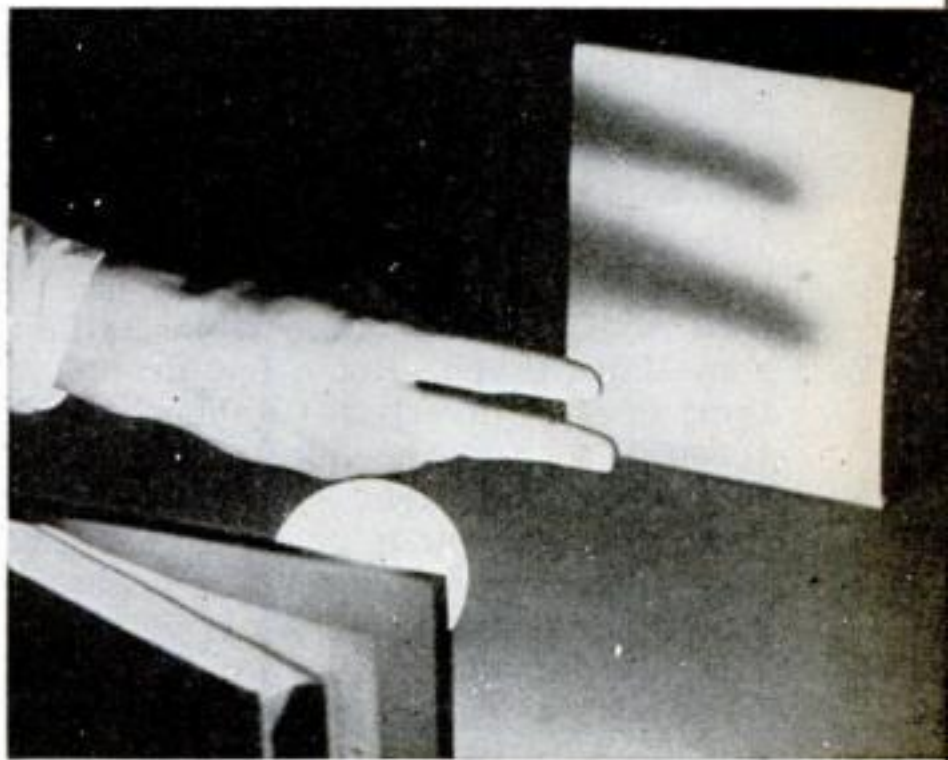
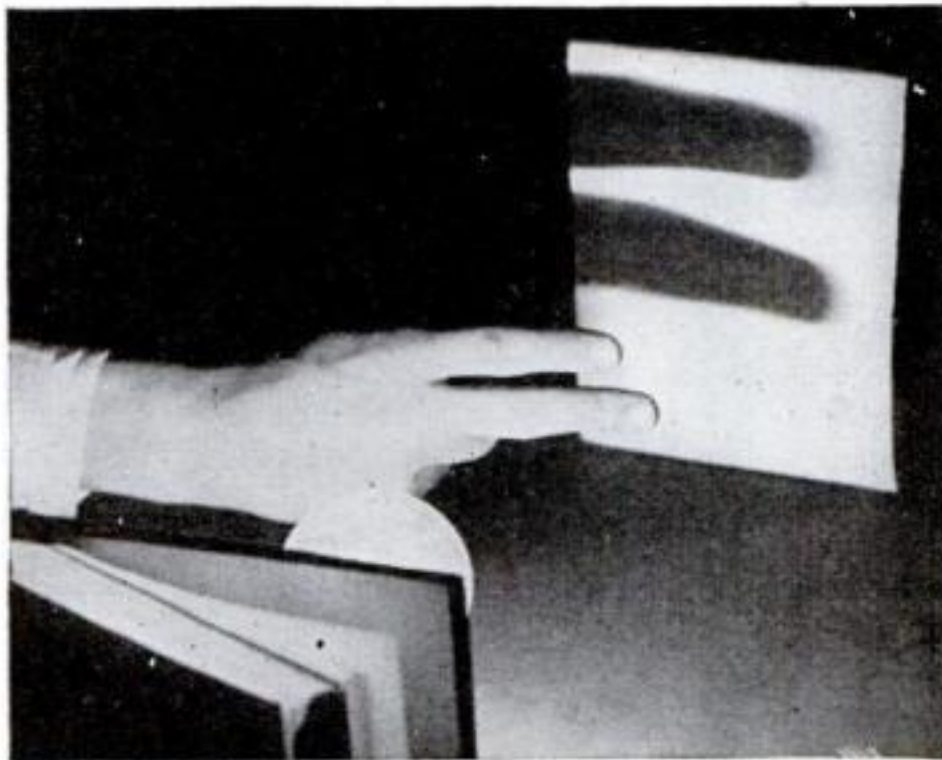
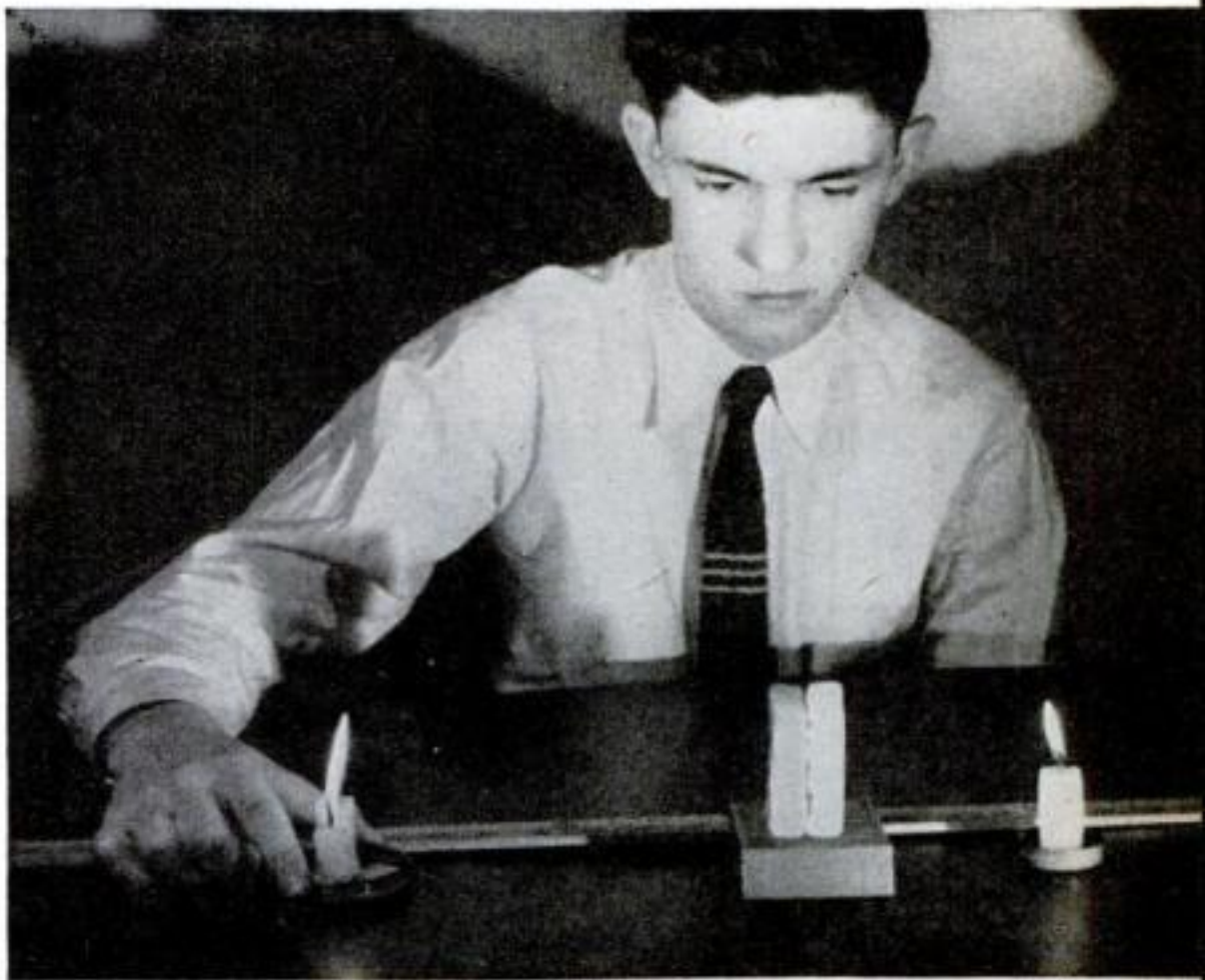
Place the composite block at right angles to a yardstick and darken the room. To illustrate the principle of the photometer, set a candle at any chosen distance, say 6", from one block. Move a similar candle back and forth along the yardstick on the opposite side of the block until the illumination of adjoining edges of the composite block is the same. If the candles are identical, the second should come to rest the same distance from the block as the first.

By the same procedure, if you know the candle power of one light, you can determine that of a second. First, find the distance from the block at which the unknown

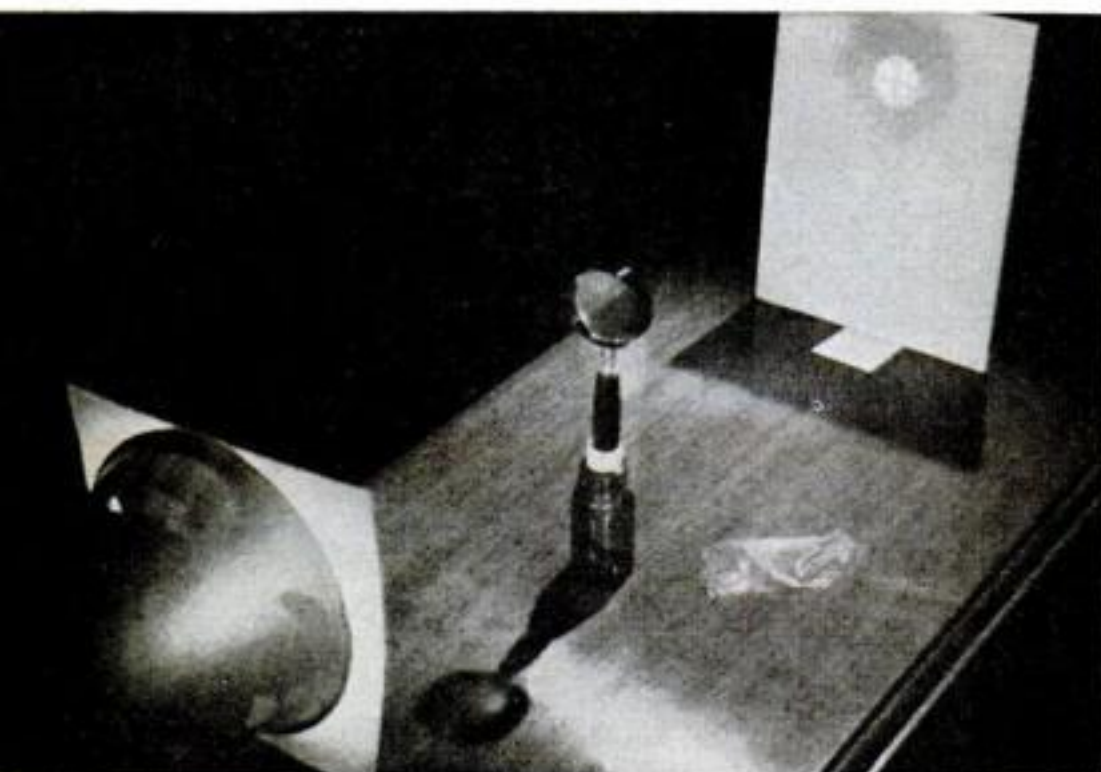
produces illumination equal to that of the known. Then divide the square of this distance by the square of the first distance and multiply by the candle power of the known light. The result is the unknown candle power.

FROSTED BULBS are superior to clear ones for general lighting because they reduce the shadows cast by small objects. Hold two fingers between a clear bulb and a sheet of paper, and sharp shadows result. With a frosted bulb, the shadows are smaller, grayer, and fuzzy. Why? Because the entire surface of a frosted bulb acts as the light

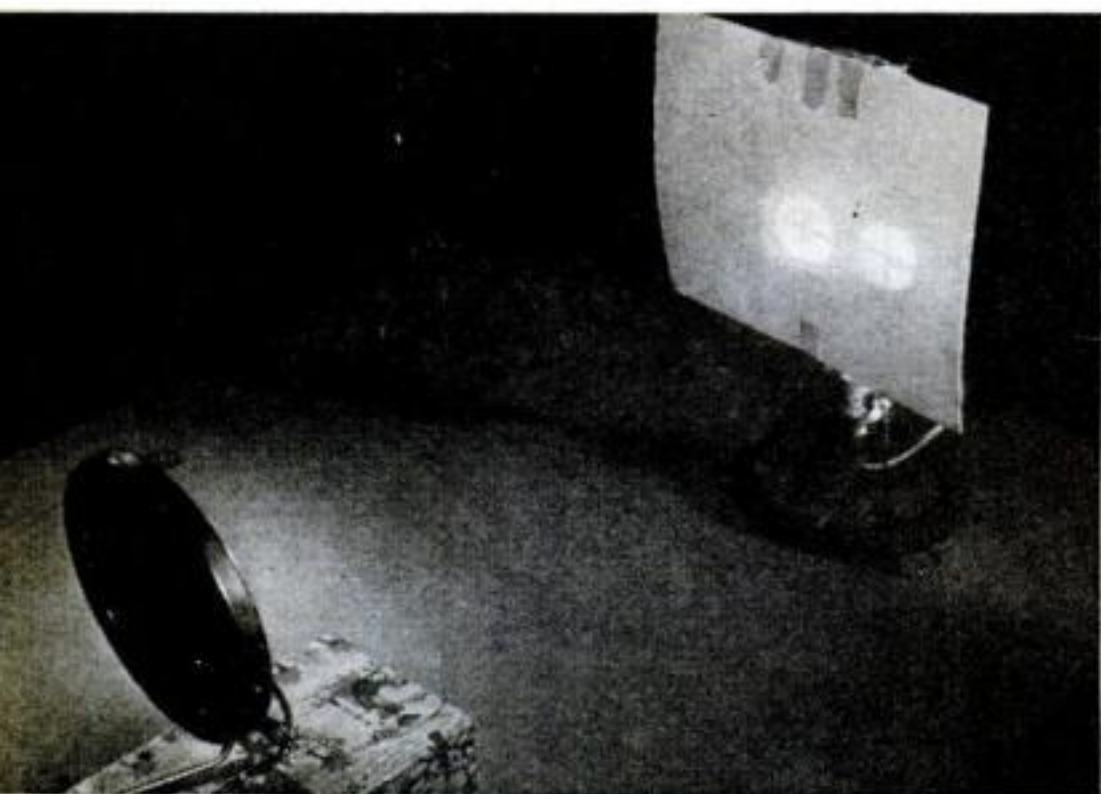
source. When the light source is smaller than the obstruction, as in the case of the filament of the clear bulb, the rays are blocked, producing a dense shadow that increases in size as the surface on which it falls is moved away. The reverse is true with a frosted bulb since the light (the entire bulb) is larger than the obstruction.



FOCAL LENGTH. Cut a triangular hole in the center of a cardboard shield placed over a lamp reflector. Now move the reflector and a white screen back and forth simultaneously on opposite sides of a convex lens, keeping both equidistant from the lens, until a sharp image the size of the triangular hole is formed. Measure the distance from the center of the lens to either the light or screen, divide by two, and you have the focal length of the lens.



COLOR FRINGES mark the images formed by a simple lens. Known as chromatic aberration, this effect results because glass bends each color ray a different amount, giving each a different focus. To show this, place a light a little closer to a lens than twice the focal length (as determined above). In a cardboard lamp mask, cross two threads over a round hole. Cover the hole with red glass and focus the image by moving the screen. Now substitute dark blue glass. You'll find that the blue image will not be sharp at the same lens-to-screen distance.



CONCAVE MIRRORS produce real images and have definite focal lengths like lenses. You can demonstrate this with the setup shown at the left. In this case, the lamp mask used in the preceding experiment also serves as the screen. Mount the mirror so that its center is directly in front of the light and move the mirror back and forth until the image is sharpened and brought down just to the size of the hole. Then the focal length of the mirror is exactly one half the distance between the mirror and the screen.

RED INK made from certain aniline dyes is sometimes green. Put a few drops on the bottom of an inverted tumbler, look directly through it, and the ink is red. But hold the tumbler so that light is reflected from the surface, and the ink appears green. Likewise, a very thin sheet of gold leaf held between your eye and a strong light is not yellow but green. The mechanism of this strange effect is not definitely known, but it results from some sort of selective reflection at the surface.



MEET H_2O_2 . . . FIRST COUSIN TO WATER

Hydrogen Peroxide

By KENNETH M. SWEZEY

NOT SO long ago a cut or bruise always meant a scamper to the household medicine cabinet for the bottle of peroxide. Dabbed or poured on the wound, this watery stuff smarted and fizzed furiously—actions which suggested that every single microbe could do no less than turn up its heels and die.

Scientific research soon proved, however, that the germ-killing power of hydrogen peroxide was greatly exaggerated; that the fizzing was caused by oxygen bubbles released by the catalytic effect of blood, dirt, tissue, and pus; and that in deep cuts such rapid evolution of gas might even cause further injury by tearing the inner tissue.

Because gentlemen (some of them, at least) prefer blondes, women long ago began turning to this interesting chemical as a hair wash. Glamorous "peroxide blondes" are the result. Because it is a strong oxidizing agent, hydrogen peroxide changes the organic pigments of the hair into colorless compounds. The "golden hair washes" now



Drop sulphuric acid into an ice-cold barium peroxide solution until it has been neutralized. This reaction produces hydrogen peroxide.

on the market are chiefly hydrogen peroxide with a trace of nitric acid added.

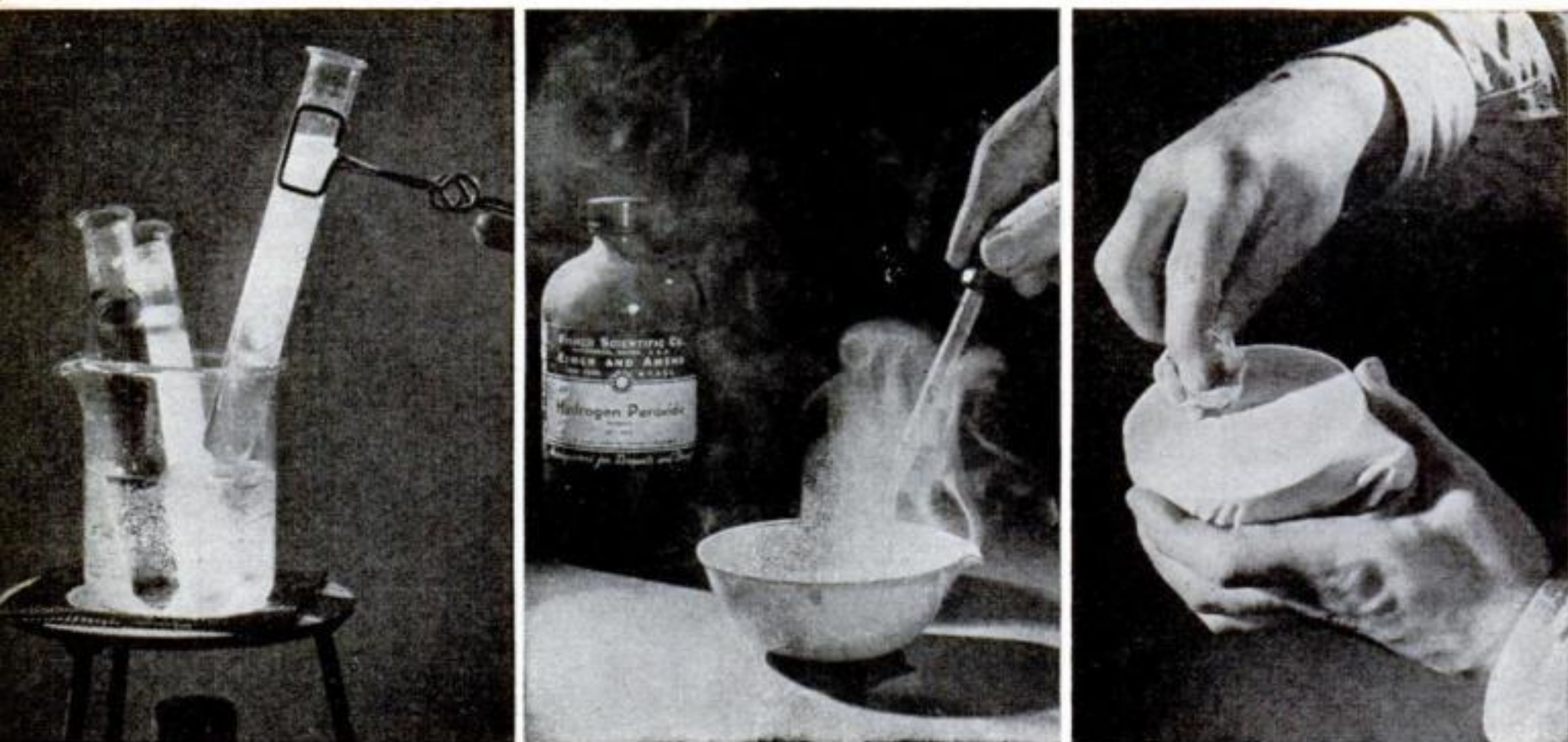
During the war, 95 percent of all the hydrogen peroxide produced has been devoted to essential civilian industry and secret military uses. The fact that it is distributed in tank-car lots indicates its importance.

Hydrogen peroxide always has been widely used as a textile bleach for it causes little harm to the cloth and the only residue left is plain water. Plants busy turning out cloth for military uniforms require large quantities for this purpose. Cotton cloth, a drab gray when it slides from the looms, is turned a permanent snow white before being made into underwear, shirts, and socks. Raw wool is bleached before being dyed.

Besides textiles, this liquid bleaches many other substances—raw sugar, tripe, fish, figs, furniture woods, casein for light-colored plastic articles, and cow and goat hair used in household items. It helps control the ever-present bacteria in gelatins used for foodstuffs, photographic films, and glue. It

Barium sulphate, which remains after reaction has produced hydrogen peroxide, must be filtered out, as at far left. Ether and an acidified potassium chromate solution in the tube just at left test for H_2O_2 . Even a trace turns the ether dark blue.





Stand test tubes containing hydrogen peroxide and various catalysts, such as powdered charcoal or chalk, in a beaker of hot water. Oxygen bubbles stream out. Center, a drop of concentrated H_2O_2 explodes when it falls on manganese dioxide. Right, it is used as a bleach to remove discoloration caused by scorch.

purifies various metal salts employed in paint making and electroplating.

Hydrogen peroxide, H_2O_2 , is produced commercially by reacting barium peroxide with dilute sulphuric acid—a process that can be carried out on a small scale in a home laboratory. The reaction must take place at a low temperature to prevent decomposition of the chemical. Put about 100 grams of chipped ice into a beaker, stir in 50 ml. of water, and dissolve in the mixture about 10 grams of barium peroxide and 2 drops of phenolphthalein solution (to serve as an indicator). Dilute 1 part of sulphuric acid with 3 of water, making certain that you add acid to water and not vice versa. Stir this, drop by drop, into the peroxide solution until the pink color disappears.

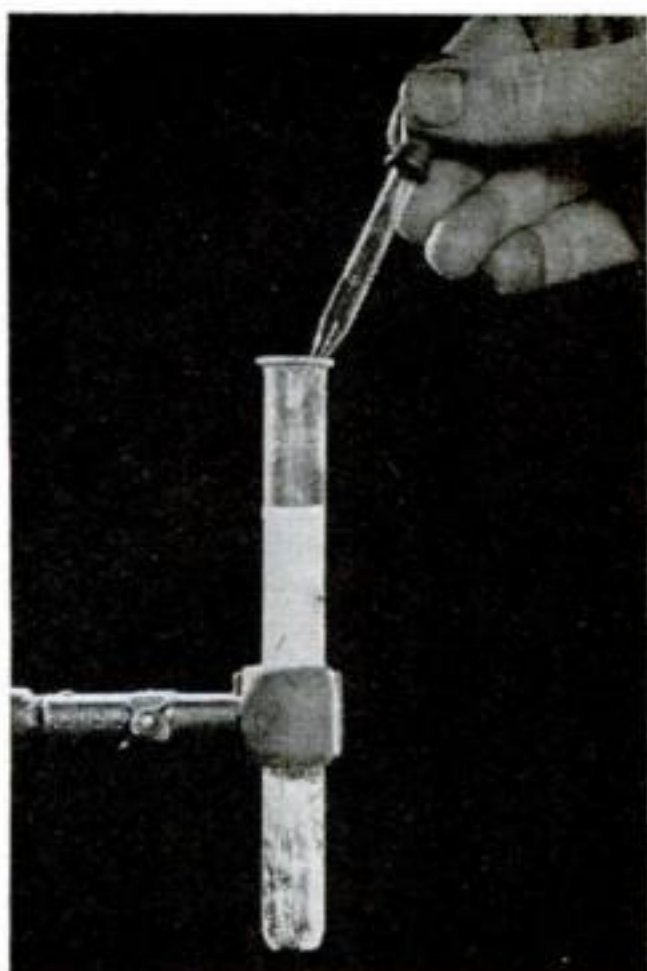
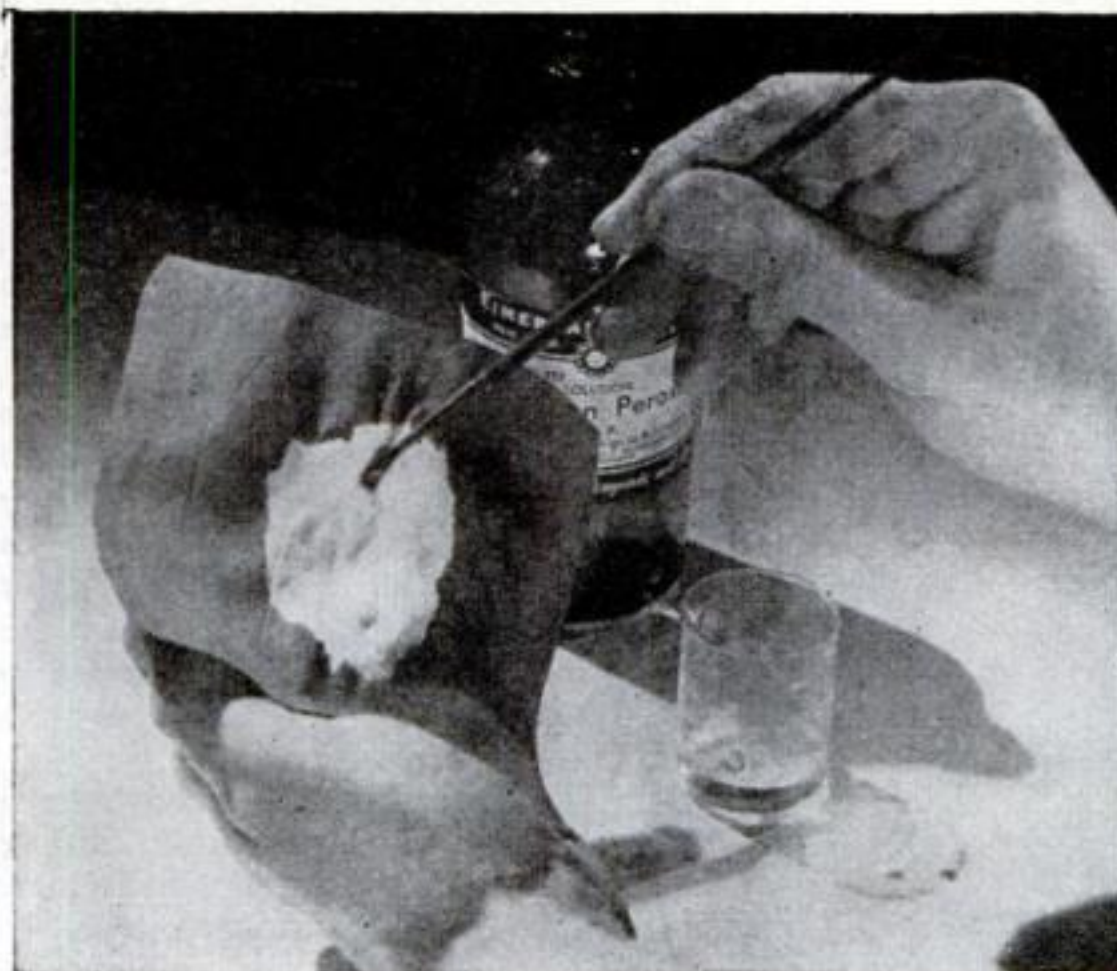
When your solution thus has been neutralized, it must be filtered immediately to remove the barium sulphate, for this fine precipitate, acting as a catalyst, promotes decomposition of the hydrogen peroxide.

A simple test, so delicate that it detects 1 part of hydrogen peroxide in 100,000 parts of water, will easily prove that you have really compounded H_2O_2 . To a test tube half filled with water add just enough potassium chromate or bichromate to produce a light-yellow color. Also add 5 ml. of sulphuric acid, diluted 1 part of acid to 3 of water. Pour $\frac{1}{2}$ " of ether on top of this and put in several drops of your peroxide solution. Stopper the tube and shake the contents. When the ether again has separated, you will find it colored the deep blue of perchromic acid, a sure sign H_2O_2 was present.

Pure hydrogen peroxide can be made, but it is extremely unstable and may decompose with explosive violence. Commercially, fairly stable solutions of 30 percent concentration are obtainable. The drugstore variety usually is a 3 percent, or 10 volume, solution of the chemical in water. Ten volumes means 1 of solution will give off 10 of oxygen.

Light, alkalis, manganese dioxide, and many fine substances all promote the rapid breaking up of H_2O_2 into water and oxygen. To demonstrate how readily it parts with its extra atom of oxygen, put a little powdered charcoal in one test tube, some powdered chalk in another, and a little sodium hydroxide in a third. Fill each of the tubes to the halfway mark with hydrogen peroxide and stand them all in a beaker of hot water. Oxygen bubbles soon begin to stream to the top in each of the tubes. But if you now add a little acid to another tube containing hydrogen peroxide and stand this in the hot water, you will notice that few, if any, bubbles are released from the fourth tube. This is because acids and certain organic substances, such as acetanilide, act as *negative* catalysts, inhibiting decomposition.

In contact with powdered manganese dioxide, hydrogen peroxide of 30 percent concentration breaks up with actual explosive violence. You can demonstrate this by placing a little of the powder in an evaporating dish and allowing a few drops of the concentrated chemical to fall upon it from a height of 6" or more. As each drop touches the catalyst, the liquid decomposes with a small explosion, releasing the oxygen



Hydrogen peroxide brushed over lead acetate darkened by hydrogen sulphide restores the original white color, left, as it will when applied to white lead paint. It also functions as a reducing agent. If a few drops are added to a solution of potassium permanganate and sulphuric acid, right, molecular oxygen evolves.

and vaporizing most of the water in a cloud of steam. *Remember that it is dangerous to decompose more than a few milliliters of such powerful hydrogen peroxide at a time. Further caution must be exercised in handling, for H_2O_2 of this concentration will injure the skin almost as badly as acid.*

In the laboratory, drugstore hydrogen peroxide is an excellent source of small quantities of oxygen. A generator is easily made. Put a little powdered manganese dioxide or a warm solution of sodium hydroxide in the bottom of a small flask equipped with a two-hole stopper. Place the stem of a separatory funnel through one hole and a delivery tube through the other. Regulate the stopcock on the funnel so that hydrogen peroxide is admitted drop by drop. Oxygen will issue from the delivery tube.

Under the proper conditions, hydrogen peroxide changes black into white. You can demonstrate this by soaking a sheet of paper in a solution of lead acetate and then holding the sheet in the fumes of hydrogen sulphide—generated by pouring a little dilute sulphuric acid on a few grains of iron sulphide in a test tube. Let the paper dry after it has become completely black. Then paint over the black surface with a brush dipped in peroxide. The black turns white.

This experiment shows why hydrogen peroxide will restore the brightness of white lead paint. Such paint often turns dark because hydrogen sulphide in the air reacts with it, producing black lead sulphide. When hydrogen peroxide is applied, the dark lead sulphide changes into white lead

sulphate. This same principle often is used to brighten old oil paintings.

Around the home, hydrogen peroxide is useful for bleaching out many fruit stains and the color from organic dyes. Scorch marks may also be removed from cloth if they are not too bad. When the spotted or marked article is small, place it bodily into warm 3 percent hydrogen peroxide. Move the article about and inspect it occasionally to note the progress. In the case of larger articles of clothing, dip the spot alone into the solution or saturate a cloth and rub it.

Strange as it may seem, hydrogen peroxide not only is a strong oxidizing agent, but it sometimes is just the opposite—a *reducing* agent, or a substance that robs oxygen from a compound. For example, it does that with potassium permanganate.

Dissolve a grain or two of this chemical in a test tube half filled with water and add a few drops of sulphuric acid. If you now add hydrogen peroxide, drop by drop, to this solution, the deep purple color will gradually disappear. The reaction is accompanied by the vigorous evolution of molecular oxygen (O_2), two oxygen atoms joined together. Although the reaction is complex, it has been proved that half of the liberated oxygen comes from the permanganate and half from the peroxide. According to one theory, the nascent or newborn oxygen liberated by the decomposition of the peroxide is so active chemically that it takes oxygen away from the permanganate in order to combine with it and form the molecular oxygen.



Hints on Closing

ers, rafts, and temporary wooden docks. Paint them so they will be ready for instant use next summer. Docks built in numbered sections are easy to handle.

Take up and store safely away from ice, snow, and tides all portable wooden boardwalks. Paint small boats and store them upside down off the ground under the cottage or in the garage. This keeps them dry and prevents nesting of rodents in them. Remove from the garage or sheds articles that might be damaged by an unusually high tide, heavy snow, or freshets.

Soak in kerosene and brush with grease all carpentry and garden tools to prevent rusting. Repaint and store lawn furniture, and store flagpole and awning lines.

Wash silverware, glassware, crockery, and cooking utensils. Arrange them in small piles, put each pile in a paper bag, close the bags tightly, and restore the articles to their proper shelves. They will be fresh and clean when you want them again. Wash lamp shades and bric-a-brac and wrap them in newspapers to protect them against fading, tarnishing, and dust. Remove draperies, wash and iron them, and store them or cover them with cloth or pillowcases.

If you have any windows that stick, wax or soap the edges. Then batten down or board up windows or close their blinds, paying particular attention to those on the weather or seaward side. Blinds or hinged battens should not have exposed hinges that can be removed by an intruder armed with a screwdriver. Windows that have no battens and

Antifreeze or kerosene in water traps will prevent damage from winter freezes.



By KENILWORTH H. MATHUS

YOU can save yourself inconvenient trips in the early spring, and yet have everything in readiness for the opening of your summer cottage or camp next year, if you go about its closing systematically this fall.

Remove from the water all buoys, mark-

Cottage-Closing Checks



- ① **PAINT:** Floors, porches, lawn furniture, docks, rafts, and small boats.
- ② **STORE:** Portable walks, buoys, docks, rafts, and small boats.
- ③ **CLEAN:** Garbage can, food containers, lamp shades, and bric-a-brac.
- ④ **COVER:** Glassware, china, silverware, cooking utensils, drapes, pillows, mattresses, vent pipes, chimney, radio, and phonograph.
- ⑤ **EMPTY:** Ink bottles, bread and cake boxes, and match containers.
- ⑥ **OPEN:** Oven, refrigerator, closets, and cupboards.
- ⑦ **SHUT:** Stove dampers and flues, blinds, and outside doors.
- ⑧ **DISCONNECT:** Electricity, gas, telephone, water, and pump.

Your Summer Cottage

can't be boarded up should be soaped on the inside so passers-by can't see in and be tempted.

Cover cracks around thresholds with old rugs or put molding or temporary weatherstripping on the outside. This is important on the weather or seaward side.

Stop up dampers and chimney flues to keep out rodents, and tie cloth over top openings of vent pipes and chimneys to shut out birds, squirrels, and field mice. Matches, if left at all, should be in a tightly closed tin box for protection against mice.

To protect your pillows against mice and to keep them from becoming musty, they should be suspended at their corners from a line strung across a room. If mouse trouble is especially acute, even heavy mattresses can be suspended from ropes if boards are used to distribute the load and to protect the mattresses from the ropes. Old sheets will serve as covers to keep off the

Carpentry and garden tools cleaned with kerosene and greased will resist rust.



dust. Mattresses can be stored instead in a closet lined with tin to make it ratproof, but if they are they will need airing in the spring.

Leave oven, refrigerator, closet, and cupboard doors open to prevent rusting and aid ventilation. The bread box, cake box, and sugar tin should be washed and also left open. Dispose of perishable food, and clean out the garbage can. Store leftover condiments and spices in airtight tins.



Silverware, glassware, and dishes stay fresh in paper bags. Soaping the windows that aren't boarded keeps passers-by from seeing in.



Empty or throw away bottles of ink and kitchen liquids. Freezing could make them overflow or crack their containers.

If you intend to put the cottage up for rent next year, post in a conspicuous place an instruction card on operation of the water pump, stove, and other equipment. This should also list the name, address, and phone number of the milkman, iceman, garbage man, a plumber and electrician, and a doctor and dentist.

Shut off the water, gas, and electricity, and have the phone disconnected. Put anti-freeze in toilet traps and the like, or have it done by a plumber. Dispose of inflammable liquids and of gas in pressure tanks.

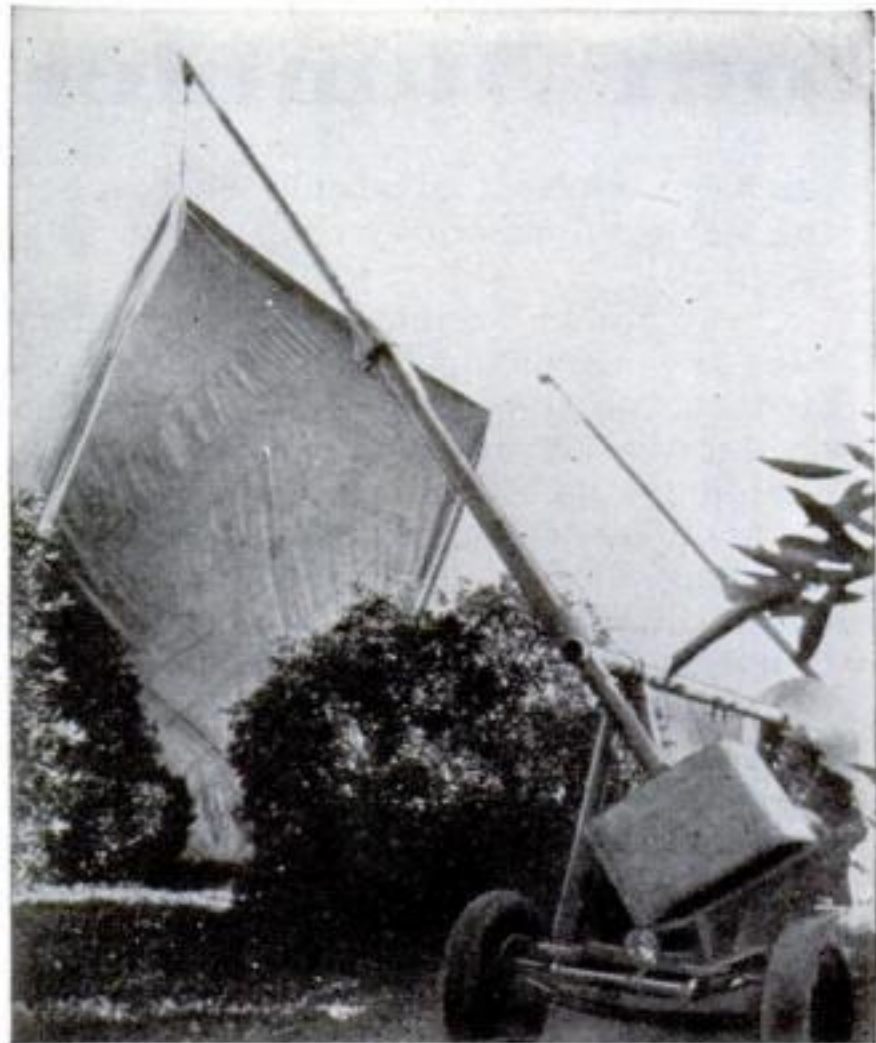
Paint or shellac inside floors, porch floors, and steps. Then you won't have to go through the drying period in the spring.

Leave a key to the cottage with a near-by winter resident or a State police barracks, and arrange with the neighbor or police sergeant to notify you in case of an emergency. Obtain permission to post a sign warning intruders: "This Property Protected by State Police." Post another with your name, address, and telephone number. Then enjoy your winter free from worry.



Citrus trees are fumigated under tents like these to control scale insects with measured dosages of hydrocyanic acid gas. The tents confine the fumes.

Octagonal tentlike canvas sheets are pulled over the trees by the counterbalanced device shown at right. It does the work of two hand-labor crews.



Mechanical Tent Puller Aids in Fumigation of Citrus Trees

WHERE labor is short in citrus groves, a homemade tent puller like the one shown at right above can aid materially by doing the hardest part of the job of tree fumigation. In use in California, such machines made from scrap have pulled fumigation tents over as many as 50,000 trees per puller a season. A single puller can cover up to 80 trees with tents in an hour.

A number of different types of machines have been devised by growers. Those in use are operated on a tractor or truck chassis and, as a rule, have two long telescoping

arms that lift up, pull over, and lower two corners of the octagonal canvas sheets that serve as tents. Some have a hydraulic mechanism, but the majority have a concrete-block counterbalance pivoting on a horizontal shaft. Truck engines operate the devices by means of power take-offs.

A patent on one mechanical tent puller is held by the American Cyanamid and Chemical Corporation, of New York, which invented the device when labor shortages first struck the citrus groves. It has been released by the company for free public use.

Caster Elevates Sickle Bar on Mower to Leave Stubble High

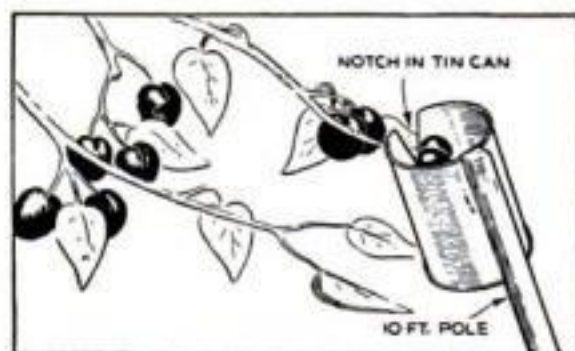


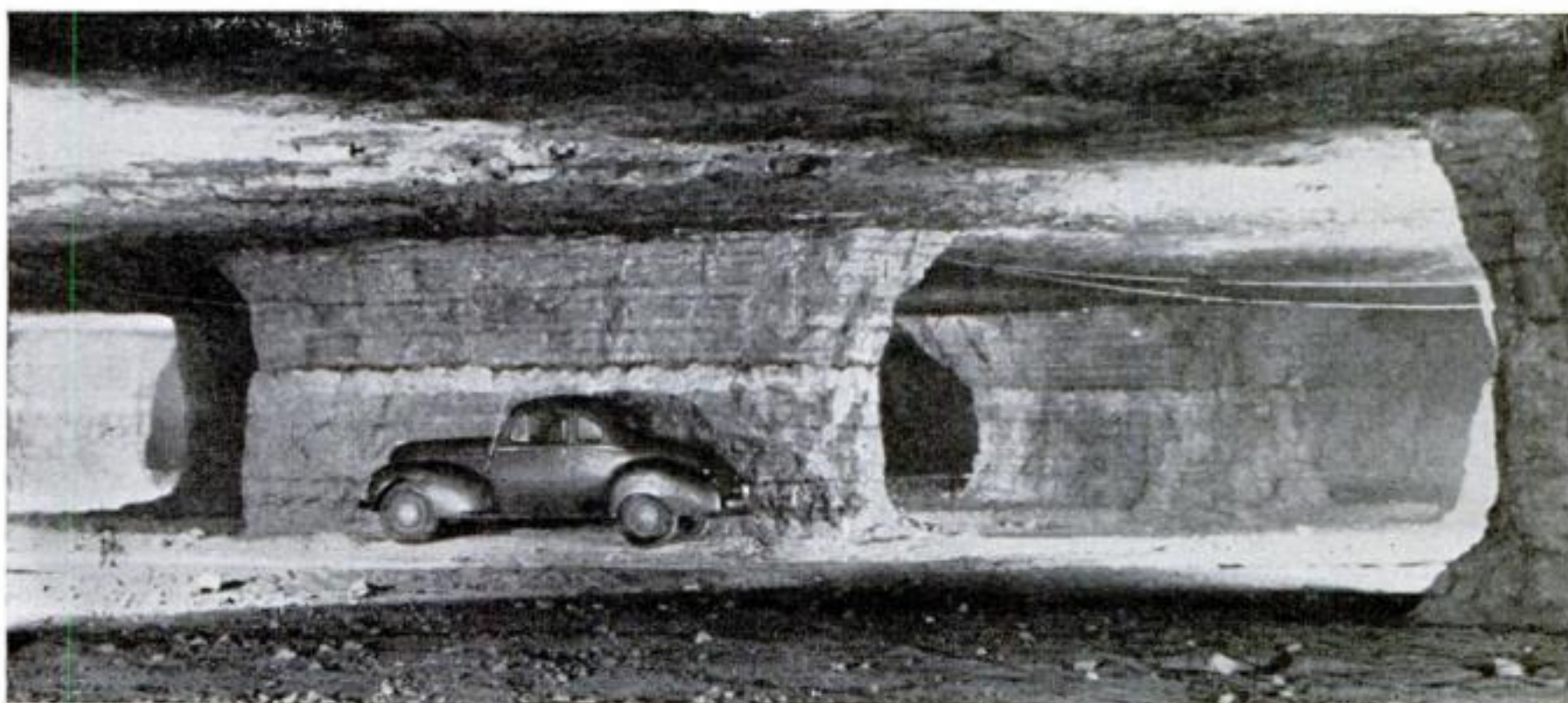
TECHNICIANS of the Soil Conservation Service at Elkhart, Kan., developed this adjustable mower caster for leaving a high stubble to combat wind erosion.

The caster shaft, about 4" long with a 60-deg. bend 1" from the lower end, fits into a 6" cast sleeve welded to the inside of the outer shoe of the bar. A take-up collar is installed through the top of the sleeve. The thrust collar at the bottom carries a felt washer. Notches in the coupling to the wheel permit height adjustment. A small trailer or wheelbarrow wheel is used.—ARTHUR W. EMERSON.

Tin-Can Fruit Picker Reaches High Branches

A NOTCH in the tin can used for this picker cuts the stem of the fruit when the pole is pushed up, and the fruit falls into the cup without being bruised. The cup is emptied into a basket when it becomes filled.—NORMAN ELISBERG.





Uncle Sam's 15-Acre Ice Box

HELPED some by nature, some by limestone miners, and some by modern refrigeration, the United States has the world's largest cold-storage plant. It is a 15-acre underground unit naturally insulated by 100' of earth and stone near Atchison, Kan., not far from the geographical center of the country. Rented by the War Food Administration from the mine company that dug it, it is intended primarily for the storage of such lend-lease and rehabilitation commodities as dried fruits and eggs, cheese, lard, and cured and salt meats.

Nature gives the huge excavation a constant temperature of 55 deg. Three compressors, each having a capacity of 250 tons of refrigeration a day, bring the temperature down to 31 deg. Double doors, like the storm doors on homes but further apart, keep cold air in and hot air out. They are opened and closed by an electric eye.

Storage capacity is from 30,000 to 50,000 tons depending on the density of the food. This void is filled from processing plants throughout the Midwest. Delivered by rail, food is put on 4' by 4' wheeled platforms for transportation to the mine.

Gasoline mules draw huge quantities of foods to the door of this underground cold-storage plant, and electric engines do the rest to prevent fumes.

This door to the huge Kansas cave is controlled by an electric eye. "Storm doors" keep the cold in. Below, freight cars unload food for storage.



Beach Busters: the LVT's

(Continued from page 124)

steep for land tanks. A high bumper bar, compared to that of a tank, gives the amphibians enough leverage to push over trees up to eight inches in diameter—a useful trick to clear ground for artillery aiming stakes. Armored amphibians make mobile fieldpieces. And although theoretically no match for tanks in combat, even amphibious tractors are unofficially reported to have destroyed Jap tanks.

The 21-foot, eight-ton Alligator was the first Amtrac to see combat action, taking part in the initial assault upon Guadalcanal on August 7, 1942. When the Japs got their first glimpse of these awe-inspiring machines crawling in from the sea, their dismay may well be imagined. According to a Marine officer who led one of the first waves of amphibians, the Nipponese departed precipitately and the Amtracs landed without appreciable opposition.

No one could expect a perfect amphibian on the first try, but the Alligators proved themselves so well in subsequent actions that many are still in use. Meanwhile, improved models had answered obvious demands for more size and power.

These were the LVT (2), the Water Buffalo, 26 feet long and of 14 tons, which first hit the Japs at Bougainville on November 1, 1943, and the first U. S. armored amphibian, the LVT (A) (1), which first saw action at Kwajalein, on February 1, 1944. Designed solely for fighting, this six-man vehicle bore the closest resemblance to a seagoing tank. The 18-tonner, armed with a 37-mm. gun, carried machine guns as well. Heavier armor protected the crew.

Combat experience, not theorizing, dictates changes in models. For example, men of the Alligators and Water Buffaloes had to disembark by leaping over the sides of the machine, and unload cargo the same unhandy way, while exposed to enemy fire. Thenceforth, Amtracs were fitted with built-in stern ramps. Impervious to the sea, the rubber-sealed platforms were readily lowered when the craft got ashore, making an easy task of unloading cargo and enabling troops to deploy under cover of the vehicle.

First of these ramp-type amphibians to introduce itself to the Japs was the LVT (4), an enlarged and improved Water Buffalo, 26 feet long, a ton or two heavier than its predecessor, and carrying an infantry platoon of 32 to 45 men, or a land-type jeep, or a sizable fieldpiece, complete with crew. It was the second unpleasant surprise of the day, June 14, 1944, for the Nipponese defenders of Saipan in the Marianas. The

first had been an advance assault by our latest armored amphibian, the LVT (A) (4)—a 20-ton fighting machine with a crew of five and a 75-mm. howitzer for its principal armament. Its shells, each measuring a shade under three inches in caliber, can be aimed to sail over ridges surrounding a beachhead and plop down among Japanese concentrations detected by aerial reconnaissance.

Military machines don't always appear in the same order as their model numbers. So it was with the LVT (3), a beautiful piece of engineering, which remained under wraps while the LVT (4) and other Amtracs led the march across the Pacific and some ferried American armies across the Rhine. Then, last Easter Sunday, the Bushmaster went into combat at Okinawa, with the result already described.

About equal to the LVT (4) in tonnage and capacity, a little shorter and beamier, the Bushmaster differs from the Water Buffalo in one outstanding respect. Its driver has practically been relieved from the tricky business of shifting gears in climbing a reef, a beach, or a hillside. For the LVT (3) employs a fluid transmission, similar in principle to those of modern cars, and automatically changes gears to suit the "road."

In round numbers, America has built something over 15,000 LVT's, according to best available estimates. Many more, and for new uses, are due.

Unarmed and unarmored, modified Water Buffaloes and Bushmasters are scheduled to appear soon. They will form the last link of our vast transportation system for reinforcements and supplies across the Pacific, to the forward combat zone where fighting amphibians take over.

Already talk is heard of odd postwar uses for demilitarized amphibians—ferrying logging equipment to hitherto inaccessible timber lands, or leading expeditions in search of rubber, quinine, and valuable minerals. For a while, these fascinating speculations must wait. The amphibians have another job to finish first.

Subscribers in the armed services who notify us of change of address are requested to give us the key symbols appearing on the wrapper in which the magazine is received.

A Flying Vacation *(Continued from page 135)*

"LAWRENCE." An arrow under it pointed south.

"But that can't be the direction of the airport," said Groenhoff. "It doesn't agree with the map."

We found the airport, after a hunt, a quarter of a mile away. The sign on the barn top pointed to the town of Lawrence. It was for motorists.

Gradually it was dawning on us why the grass airports for private flyers scattered throughout the country were, by and large, unmarked. The local operators on them, who doubled in brass as airport managers, made their money by selling instruction time and retailing airplanes. They weren't accustomed to itinerant traffic. They were penny-wise and pound-foolish. What good was it going to do them to teach people to fly and to sell airplanes if the planes couldn't go somewhere in safety?

Yet, with one exception—at a field run by a bilious, aging gentleman who didn't want to be bothered—every one of the operators went out of his way to help us. The Hutchinson man called the weather station for us. The wife of the man at Lawrence argued on the telephone until she got us a hotel room. The operator at Garden City took us sightseeing in his car. The one at Du Bois, Pa., drove us into town for lunch, and the one at Chicago left one of his own planes out in the open overnight to give us hangar space.

On our last lap but one to Chicago I warned Groenhoff, at the controls, "Someone may have thrown a switch at the next railroad crossing. Watch out or you'll get off on the wrong track." He grinned.

We crossed a crossing. Five minutes later I glanced at the compass. "Where do you think you're going?" I asked.

Someone, sure enough, had thrown a switch. It took us ten minutes of diving on railroad stations to see if we could read the signs, of map study and radio-beam orientation, before we got back on course.

I directed him to an airport. "Where are we?" he asked, as we landed for fuel.

"Burlington."

"Burlington what?"

"Iowa."

"How did we get into Iowa?" When you fly several hundred miles between stops, your geography gets mixed up.

At Chicago we had to hunt for the airport for only five minutes. It was a record.

At Sandusky, Ohio, we swooped down on one of the finest private flying fields that we encountered in the whole trip.

"But why don't you put a big white circle on the field?" I asked the manager. "It would be good for business."

For answer he beckoned us into his car. He drove out to the center of the field. There was a circle there, all right. Time had dimmed it.

"As soon as I can get help," he said, "that circle will be fixed up."

The radio battery was going dead. We stopped at Cleveland for a new one. Jim Borton, manager of General Airmotive Corp. and an old friend, shook his head. The war, he said.

"I don't relish flying over the Alleghenies without a radio," I told Groenhoff. "You did it two weeks ago," he reminded me.

That Canadian air had moved east. The ceilings were lowering. Over mid-Pennsylvania I was doing the flying. Groenhoff was navigating.

"Let's get down," I said. "The stuff is on the mountaintops."

"There's an airport three miles ahead of us," said Groenhoff. What a navigator! We put in at Du Bois and waited for the stuff to lift.

The clouds went up just enough, no more. It was touch-and-go flying. Bits of cloud whipped by the wings. I flew generally eastward but dodged here and there, looking for clear spots in the sky.

"Go ahead," said Groenhoff. "Fly where you want to. I'll follow you on the map." If you don't think he had a hard job, try it some time.

Presently he said, "This next ridge is the last big one. We'll hit a series of nice valleys. It will be clear sailing from there on."

It was, too. Spasmodically the sun came out. I rocked the wings and did roller-coasters with the elevator.

"We never could have gone as far as we did in so short a time in an automobile," I said.

"It is generally conceded," replied Groenhoff, "that an airplane is faster than an automobile."

I looked across at him. He was sober-faced.

In our two weeks' air vacation, we had covered 3,430 miles in 52 hours and 20 minutes of flying time—which gave us an average travel speed of 65½ miles per hour. The costs chargeable against the plane (fuel, oil, hangar rent, repairs, phone calls, and taxi or bus fares) came to \$123.28. That made the operating cost per mile a little less than four cents—two cents for each of us. A bargain, we called it.

Evolution of the Machine Gun *(Continued from page 119)*

manufacturers. The Lowell, a short-lived type, followed the Gardner. In 1885 Hiram Maxim displayed his machine gun, which was followed by the Hotchkiss.

The Maxim introduced several revolutionary features to the automatic-weapon field. The action, for the first time, was completely automatic. The gunner merely pulled the trigger; the weapon fired, recoiled, ejected the spent round, reloaded—and repeated the performance as long as the ammunition was fed.

Another feature of the Maxim was the single barrel. A water jacket completely surrounded this one barrel and cooled it. Combined with these developments was a new-type feed. All feeds previous to the Maxim had depended upon gravity, but this weapon took its shells from a canvas belt which ran through the action from a box. This combination of water cooling and belt feeding increased the sustained rate of fire. The Maxim was the forerunner of modern automatic weapons.

Closely following the Maxim, John M. Browning developed the Colt Browning automatic gun, which was adopted by both the Army and Navy and was used extensively during the Spanish-American War. The Browning was an air-cooled weapon. It used the gas of an exploding cartridge, which was diverted through a small port in the barrel, to drive a piston sliding in a cylinder attached below and parallel to the barrel. This, in turn, actuated the operating mechanism. This American weapon also was used by most of the European nations.

In 1906 the Schwarzlose machine gun, manufactured in Austria, was hailed as an innovation in automatic arms. It was modeled after the Maxim gun, but was greatly simplified.

The Lewis gun, invented by an American Army officer, was adopted by Great Britain as one of its standard machine guns in 1909. Improved models are still in use today. One of the first light machine guns, the early Lewis weighed 25¼ pounds and could be fired from the shoulder. A 49-round magazine fed the weapon, which had as one of its outstanding features a type of "forced draft" cooling of the barrel. The Vickers machine gun and the Bren gun are also used by the British Army.

Paralleling the Lewis gun was the Madsen, invented in Denmark, weighing only 15 pounds. This weapon was seriously considered for use by the American Army in the 1920's.

During the years preceding America's

entry into the First World War, it became increasingly apparent that the United States needed automatic weapons of its own design. The line of Browning automatics was the answer. The Browning Automatic, or BAR, was similar to the Madsen but has proved superior. The second of this family was the Browning water-cooled machine gun, which was the standard heavy machine gun of this country in the First World War, as it still is today.

The M1919A4 was the fourth of the series. A heavy barrel, surrounded by a ventilated jacket, dissipates heat fast enough to fire comparatively long bursts without burning out the riflings. However, it cannot fire for as long periods as can the water-cooled models.

The Browning .50 caliber machine gun completed the balanced automatic-weapons group. This long-range, heavy-hitting weapon helps to make America's warplanes among the most heavily armed in the world. Other models with longer barrels are mounted on trucks and half-tracks to battle enemy aircraft attempting to strafe motor columns and beachheads. Water-cooled models hurl luminous streams of tracers from antiaircraft mounts on ships at dive-bombing pilots.

These are by no means all the automatic weapons in America's bag of fighting weapons, but they are the basic types.

The Japanese have developed a complete line of automatic weapons. They are named after their inventor, Nambu—who, incidentally, picked up some of his ideas from foreign arms. Many of the weapons used by the Nips were captured at Singapore, Hong Kong and Manila, and the weapons of almost every nation have been found on Pacific battlefields. For lightness and efficiency in jungle areas the Japanese weapons are considered good, but in obtaining this lightness the Japs sacrificed hitting power. They began a late change-over in their weapons from the .256 caliber to .303, which is slightly larger than the American .30 caliber.

Development of the machine gun has faced certain limitations. These are primarily cooling and ammunition supply. The water-cooled barrel and the air-cooled barrel are at present the only answers to the problem of overheating.

The trend in automatic arms is toward lightness and mobility. The earlier weapons strongly resembled the cumbersome artillery of the time, while today's machine guns are streamlined and light enough for both jungle and mountain warfare.

Outwitting the weather



How science copes with Old Man Weather is illustrated by these ideas and devices from General Electric laboratories.

How high are the clouds? A ceilometer measures this for airmen. How wet is the weather? A fungus farm in a G-E laboratory helps design military equipment to resist fungus in the world's wettest areas.

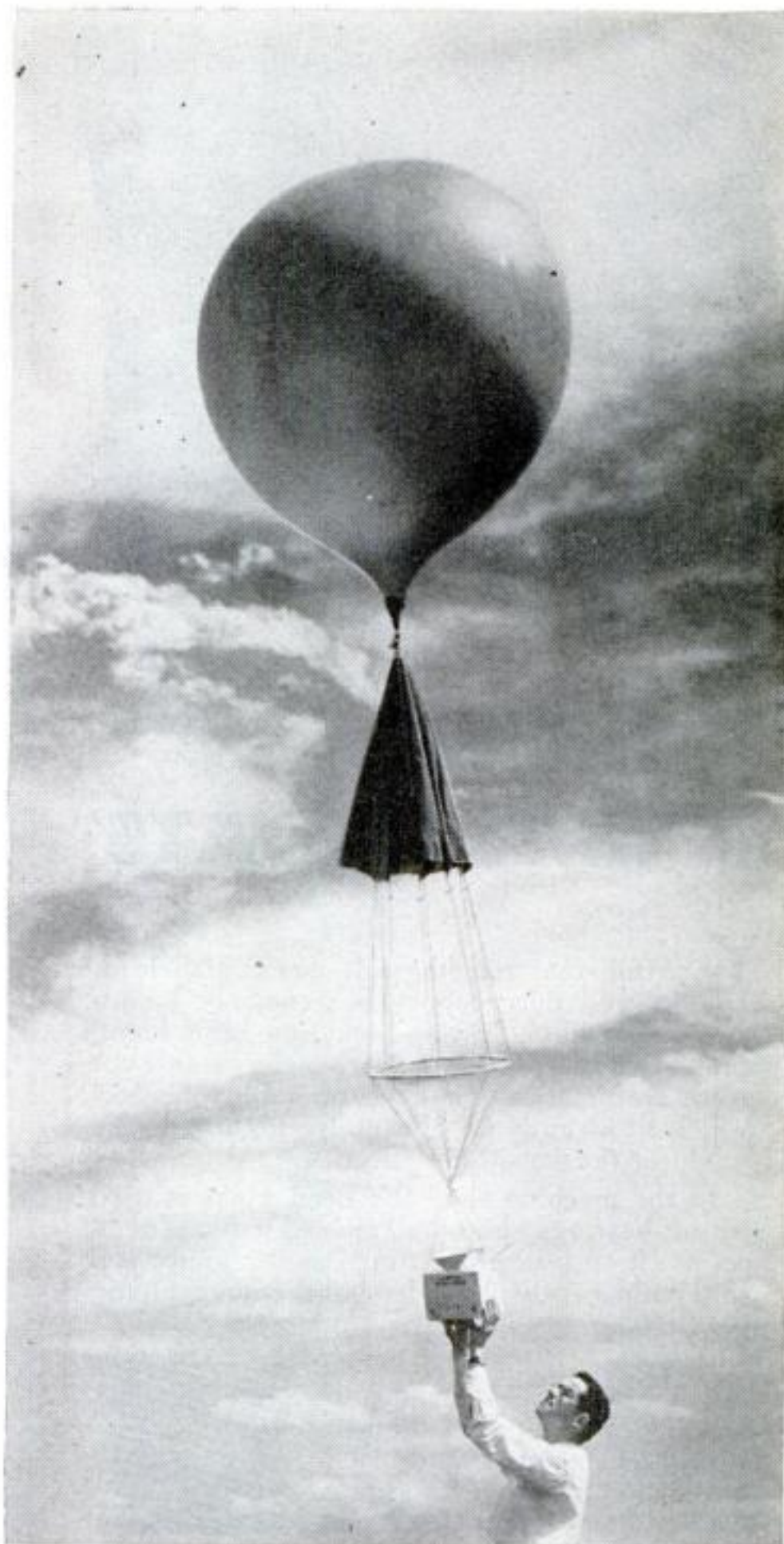
On this page are a few more examples of the way General Electric research and engineering are being devoted to this phase of human comfort and health. *General Electric Company, Schenectady, N. Y.*



Cloudy but bright. When clouds darken the sky, lights come on in this schoolroom. No one has to remember; a General Electric automatic light control with an "electric eye" keeps constant watch on daylight, safeguards young eyes by turning on the lights whenever they are needed.



Cucumber magic. Vines in electrically heated soil (right) grew twice as tall, and bore one month earlier. The heating cable, developed by G-E engineers, is buried in the soil and thermostatically controlled. More than 15,000 commercial growers use G-E soil-heating cable.



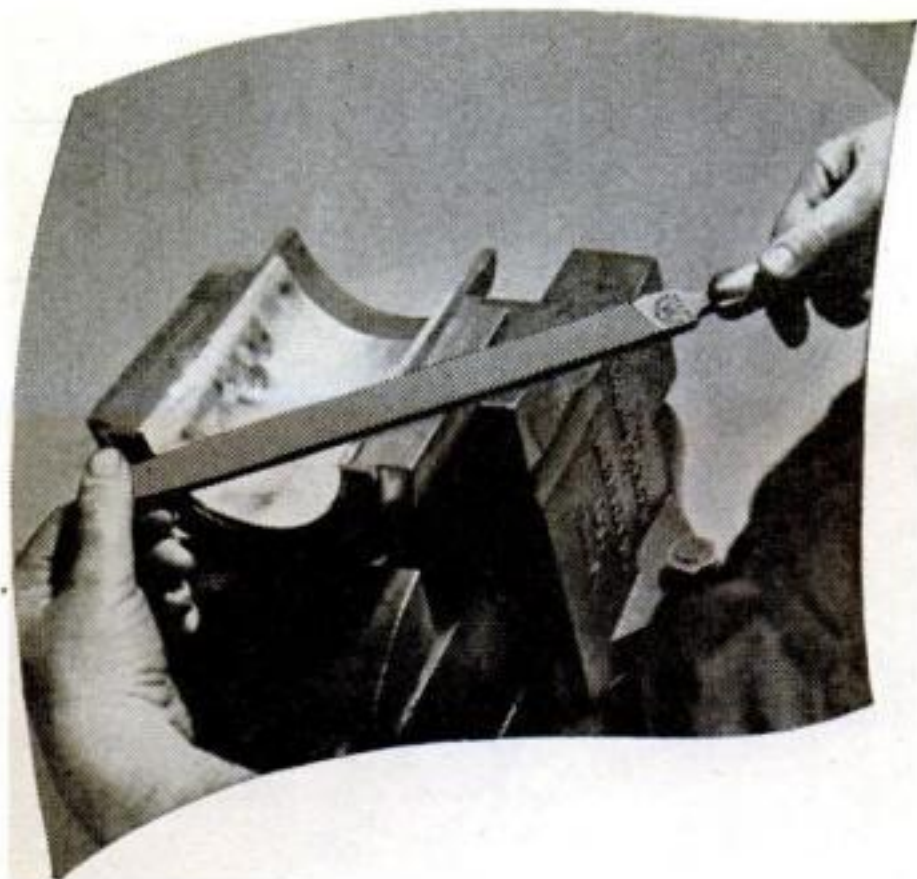
Weather detective goes aloft in the small box suspended from the balloon. Some 12 miles up the balloon bursts, and the box is parachuted back to earth. On the way up, this electronic device, called the G-E Stratometer, gives a running commentary on the weather—temperature, humidity, air pressure—and sends this information back to earth by radio signals. The information gathered by the G-E Stratometer can be used to help predict the weather.

★

Hear the G-E radio programs: *The G-E All-girl Orchestra*, Sunday 10 p. m. EWT, NBC—*The World Today news*, Monday through Friday 6:45 p. m. EWT, CBS—*The G-E House Party*, Monday through Friday 4:00 p. m. EWT, CBS.

FOR VICTORY—BUY AND HOLD WAR BONDS

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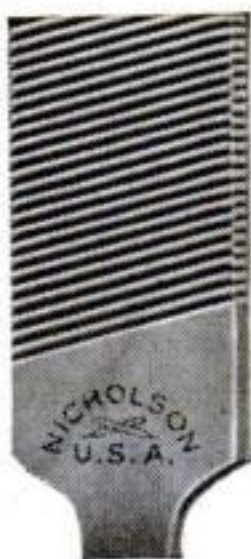
THE FILE THAT "FLOATS"

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Radar Sees the Invisible

(Continued from page 71)

bombers could be detected soon enough for defending fighters to intercept them. After the fighters took off, they had to be guided along a course of collision or interception so that they could find the bombers in the dark. During the Battle of Britain, the night fighters did their best work after making visual contact by the light of the moon or in the reflected glow of burning London.

In the Black Widow episode at the beginning of this article, part of the trick was identification. An airplane or ship looks the same in the radar operator's scope, or "scan," whether it is friend or enemy. This uncertainty is eliminated by auxiliary radar apparatus known as "IFF" (Identification of Friend or Foe). All Allied aircraft and vessels carry a specially designed radio transmitter and receiving unit called a "transponder," whether or not they are provided with any other radar equipment. When we detect something with our radar, operators send out a challenging signal that says, in effect, "Give the password and be recognized."

This challenging beam enters the receiving unit of the plane or ship being queried and passes on to the transmitting unit to spring a triggering device. The automatic action causes a friendly plane's transponder to emit a series of properly coded signals which are picked up on the challenger's scope. If it is the right code of the day, or the hour, a certain pattern is then formed on the scan of the questioning radar set. If no pattern, or the wrong one, appears, the detected object is considered hostile.

IFF sets can also be used as an aerial guide or beacon to lead other planes without the enemy's knowledge. By setting a switch, the RO causes the transponder to send forth a series of steady signals that say to other planes—merely through the pattern on the scan—"Come here," or "Follow me." Craft tuned to the proper frequency can "home" on this plane just as they would head toward a beacon on the ground. Thus, it is possible for a pathfinder or a formation leader to beckon other planes to the spot where he locates the enemy fleet in hiding without tipping his hand to the foe. When a pilot is forced down, this homing signal can also be used to attract rescuers.

Paratroopers and glider units use a condensed version of IFF for landings in hostile country. A pathfinder transport locates the most suitable drop zone and one or two paratroops are dropped carrying with them

(Continued on page 214)

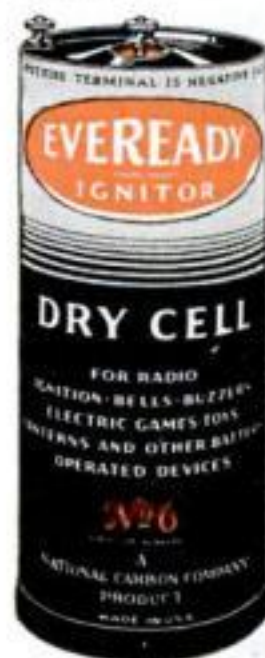
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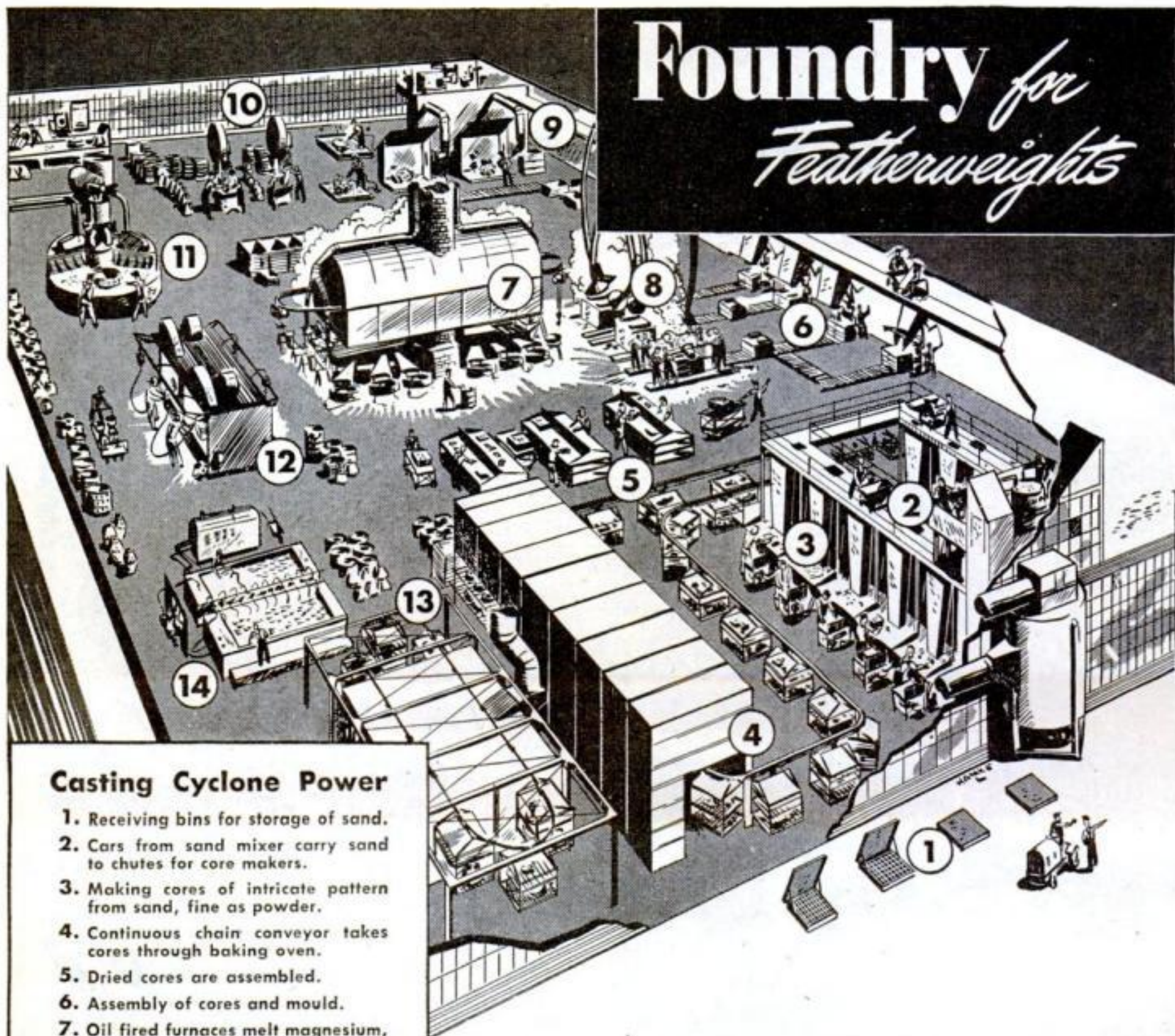


Let's get the Jap—and get it over!



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Foundry for Featherweights



Casting Cyclone Power

1. Receiving bins for storage of sand.
2. Cars from sand mixer carry sand to chutes for core makers.
3. Making cores of intricate pattern from sand, fine as powder.
4. Continuous chain conveyor takes cores through baking oven.
5. Dried cores are assembled.
6. Assembly of cores and mould.
7. Oil fired furnaces melt magnesium, kept covered with "flux" of borax and sulphur to prevent burning.
8. Pouring molten magnesium at exactly controlled temperatures.
9. Shake out screens remove casting, also sand for reclaiming.
10. Saw cuts excess metal from casting.
11. Sand blasting, casting inspection.
12. Burring and grinding rough spots and inspection.
13. Conveyor takes castings through heat treating furnace.
14. Compressed air test under water checks any possible flaws and cracks.

Magnesium is a metal one third lighter than aluminum, strong as iron. In this Wright Aeronautical foundry, it is melted and cast into parts for Wright Cyclone aircraft engines.

On a bomber powered by four Wright Cyclones, use of magnesium saves enough weight to add two extra gunners, or 75 more incendiary bombs, or two additional barrels of gasoline for more range.

A pioneer in casting magnesium, Wright Aeronautical uses this metal as one more means of adding speed, range and load to planes by building powerful engines without dragging weight.

Send for "ENGINELOGY"—25¢

Learn more about aviation's source of power. Enginology explains supercharging, combustion and engine principles in non-technical terms; describes their relation to planes and propellers. Just send 25 cents in U.S. coin to:

Wright Aeronautical Corporation
Dept. PS, Paterson 3, New Jersey



WRIGHT

AIRCRAFT ENGINES

DIVISION OF

CURTISS  WRIGHT

FIRST IN FLIGHT

Here's how your car feels after MARFAK chassis lubrication

THE REASON WHY: Texaco Marfak lubricant provides a tough, adhesive film that *cushions* chassis bearings against road shocks, increasing the riding comfort of the car and adding substantially to its life. Marfak maintains its consistency at the outer edges of the bearings, sealing itself in and sealing out grit and dirt.

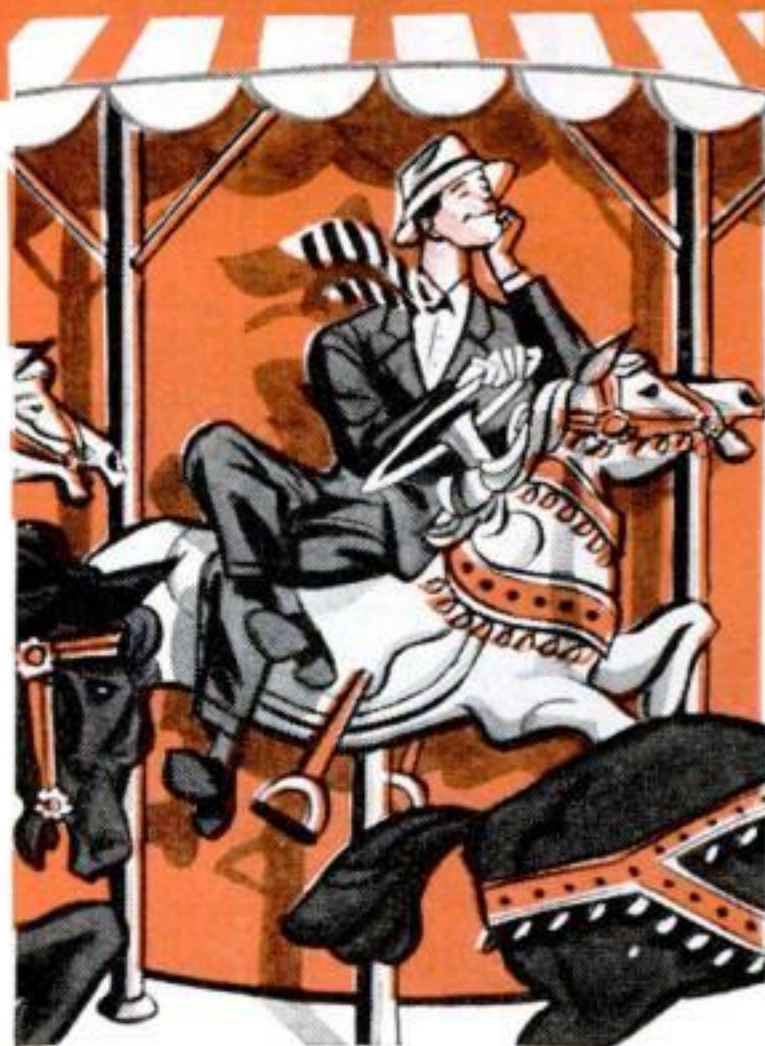


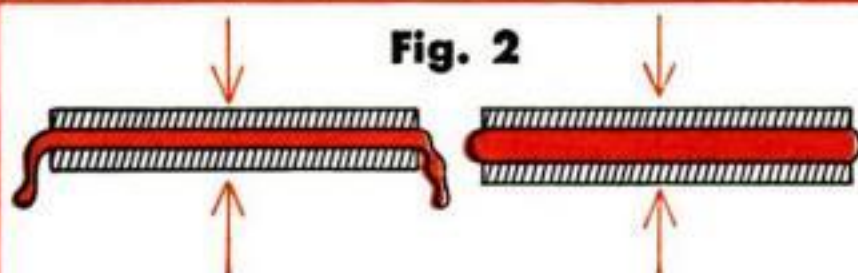
Fig. 1



Marfak cushions the blow, sticks to the job, doesn't spatter when given the hammer test. Ordinary lubricant spatters in all directions, flying away from the job.

Marfak chassis lubricant is scientifically designed to fully protect bearing surfaces against the destructive action of friction *and* road shock. You can *feel* its cushioning effect as you drive. Marfak has cohesive and adhesive qualities that make it cling to bearing surfaces

Fig. 2



A lubricant that is lacking in cohesive and adhesive qualities squeezes out of the bearings.

The cohesive and adhesive qualities of Marfak chassis lubricant keep it together and sticking to the job.

and resist any tendency to wash-out, jar-out or squeeze-out, see Fig. 2.

Turn to Marfak protection today!

THE TEXAS COMPANY



Don't miss the **TEXACO STAR THEATRE** on Sunday nights with **JAMES MELTON** and famous guest stars. See your newspaper for time and station.

You're welcome at **TEXACO DEALERS**

Let us
MARFAK
your car





You'll see when you smoke I.C.

Do the gals go for the magical I.C. aroma? *You'll see!* Will your taste-buds pur-r-r over the magical I.C. flavor? *You'll see . . .* when you light up the magical Irish Castle mixture of *eight* of the world's finest tobaccos. Eight, count 'em . . . 3 kinds of Turkish, 2 choice Virginias, 1 rare White Burley, 1 Latakia, 1 Perique. Blended by the master of 'em all, *Willoughby Taylor*. To get the gals—or just to pamper yourself—get magical Irish Castle Pipe Mixture, *quick!*



**IRISH
CASTLE**

GET ACQUAINTED SPECIAL

For a limited time (and only if your dealer is out of stock) we'll send you a half-pound humidor of Irish Castle Pipe Mixture for only \$1.10. Mail coupon with cash or check to Penn Tobacco Co., Dept. PS Wilkes Barre, Pa.

Name _____

Address _____

Radar Sees the Invisible

(Continued from page 210)

a light, battery-operated radar set. This is a small beacon, even more compact than a hand talkie, with a short whip antenna that is set up as soon as they land. Aboard the transports that follow, flashing red lights notify pilots and jumpmasters when the drop zone has been reached.

"Racons" are probably the largest RADAR beacons in use. Twin transmitter towers are permanently located so as to permit a plane to home on their signals or use them for plotting position. The beacons usually operate only when the beams from an airplane's search radar come in contact with them. These pulses automatically trigger off the beacon transmitters in the two towers.

Complete networks of racons now make possible a new system of long-range air navigation. The plane's special receiver, manned by the navigator instead of the radar operator, is tuned to catch these beacon beams. The pulses are emitted as coded signals, and each beacon has its own identifying code. In the radar scan, the plane's navigator can determine by the light traces the identifying number of the beacon station's beam. Each beam's path is represented as a curved line on a chart. The navigator then tunes in another station to get a cross bearing. Where the lines intersect is the position of the plane.

For the most part, these beacon stations are set up along coastlines; they do not function over long distances inland because of the many "permanent echoes" established by hills and other terrain features. The guiding signals can be picked up at night as far away as 1,200 miles. This new system is considered by many airmen to be just as accurate and much quicker to apply than the standard celestial navigation methods. It can be used in bad weather when there are no planets visible. The stations, each with its twin tower installation, are located from 300 to 400 miles apart. Smaller, intermediate "slave stations" with single transmitter towers are spotted between the main beacons.

There is also a short-range air-navigation system accurate enough to use for area bombing. Stations with single-tower transmitters are spaced close together and permit fixes within a matter of yards. Both the long- and short-range systems were originated by the British and improved to their present state of efficiency by American technicians.

(Continued on page 218)

GIVES HORSEPOWER MORE ZIP!



CASITE

Guarantees better and smoother performance or double-your-money-back

**CLEANS OUT MOTORS
KEEPS MOTORS CLEAN**

Enjoy the thrill of a clean, smoother running motor. Use CASITE! It's simple, swift, sure . . . just a pint in the crankcase every oil change and a pint through the air intake every three months. At service stations, car dealers and garages, everywhere.

GUARANTEE

Add Casite to crankcase and run through air intake according to instructions, then drive your car 100 miles or for 60 days, whichever is first. If not convinced that Casite gives you better and smoother performance, you get double-your-money-back by filling out guarantee certificate and mailing it to The Casite Corporation, Hastings, Michigan. Maximum refund is \$1.30 per pint, twice the nationally advertised price of Casite.

THE CASITE CORPORATION
Hastings, Michigan



65¢ A PINT

What every aircraft engineer *knows*

(The following message is taken from a recent Consolidated Vultee magazine advertisement entitled, "The Joker in Air Power," addressed to the American public.)

EVERY AIRCRAFT engineer who ever saw the inside of a wind tunnel *knows* what the joker in Air Power is.

The joker in Air Power is TIME—the heart-breaking months and years it takes to design, to build, and to perfect a plane to the point where it becomes an efficient, service-tested battle plane, ready for action.

In aerial warfare, the nation that depends on mere *quantity* and *present-day superiority* of its planes cannot win. That is one reason why Germany lost.

Progress in aeronautics is now so rapid that today's "hottest" combat plane is virtually

obsolete tomorrow. It must be replaced, with all possible speed, by new planes now on our drafting boards, in our wind tunnels, or undergoing test flights.

These are facts which an alert America should not, *must not*, forget.

Research and development in the field of aeronautics is an insurance policy on the life of the nation.

And we must not let a single premium lapse!

**Let's keep America
strong in the Air!**

CONSOLIDATED VULTEE AIRCRAFT CORPORATION

San Diego, Calif.
Vultee Field, Calif.
Fairfield, Calif.

Tucson, Ariz.
Fort Worth, Texas
New Orleans, La.

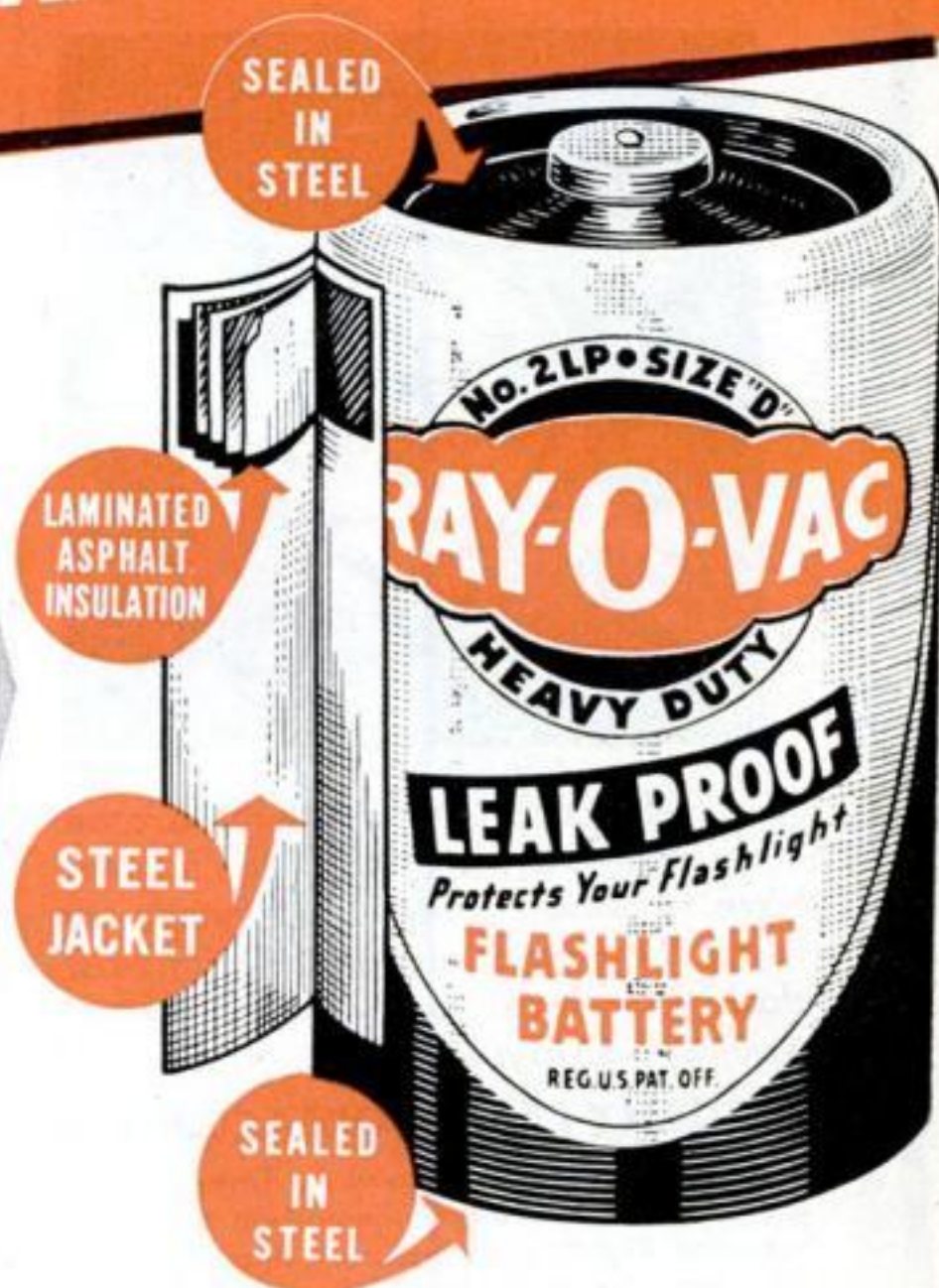
Nashville, Tenn.
Louisville, Ky.
Wayne, Mich.

Dearborn, Mich.
Allentown, Pa.
Elizabeth City, N. C.

Miami, Fla.
Member, Aircraft
War Production Council

THIS AMAZING FLASHLIGHT BATTERY
STAYS FRESH
 FOR WHEN YOU NEED IT -
 EVEN FOR YEARS AND YEARS

Here's the Patented
RAY-O-VAC
LEAKPROOF
CONSTRUCTION



FREE
 FLASHLIGHT

READ THIS
 GUARANTEE!

"We will give you
 FREE a new com-
 parable flashlight
 if yours is ever
 damaged by cor-
 rosion, leakage, or
 swelling of this
 LEAKPROOF cell."

It's **SEALED-IN-STEEL**
Top, Bottom and Sides
 And it's **LEAKPROOF 2 WAYS**

1
2

Power is sealed in—your flashlight works when you
 need it, even for years and years.

Ingredients are sealed in—your flashlight is pro-
 tected against ruinous corrosion and swelling of
 cells (see guarantee).

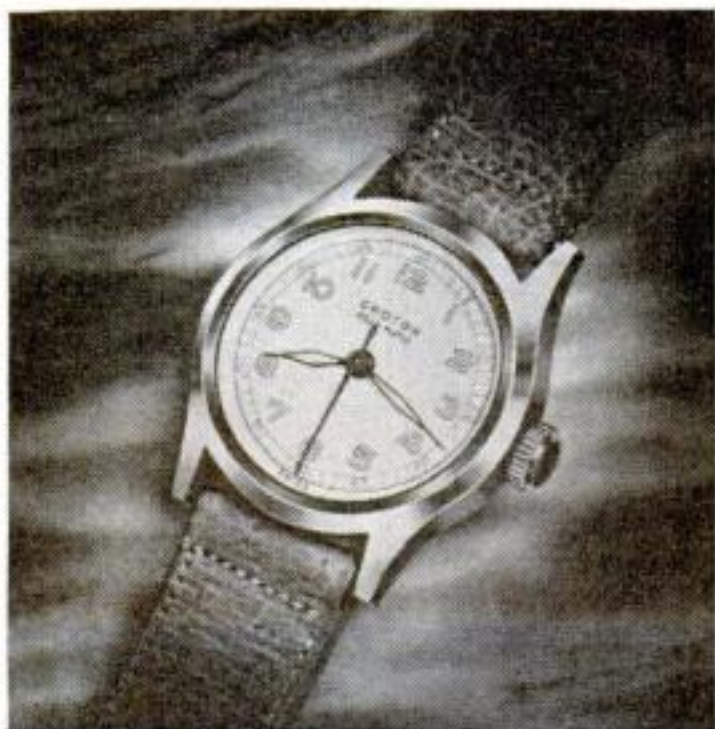
RAY-O-VAC COMPANY

MADISON 4, WISCONSIN

OTHER FACTORIES AT CLINTON, MASS. • LANCASTER, OHIO • SIOUX CITY, IOWA • FOND DU LAC, WIS. • MILWAUKEE, WIS. • KANSAS CITY, MO.

"inside story"

of the waterproof watch you never have to wind!



You'll tell accurate time with this Croton Waterproof Aquamatic. But you'll never have to wind it, because it winds by itself! *The natural motions of your wrist do it.* Therefore, your watch is always wound — always on time.

ACTUALLY 13.5% MORE ACCURATE

A famous laboratory proved it. Three Croton Aquamatics in a 30-day comparison test were reported 13.5% more accurate than the average of nine well-known stem-wind watches when checked against a standard time signal. You've dreamed about this kind of "automatic" timekeeping — now you can have it!

This Croton has everything. Wear it when you bathe or swim, it's waterproof — shock resistant, tarnish proof. Also radium dial, sweep second hand, unbreakable crystal. Everything you want in a fine 17-jewel watch (plus self-winding) for only \$49.50. Fed. Tax Incl.

P. S. Write for Booklet J20.
Croton, 48 W. 48th St., N. Y. 19

Croton SELF-WINDING

WATERPROOF AQUAMATIC

Radar Sees the Invisible

(Continued from page 214)

The basic radar equipment for distant reconnaissance and navigating is known as the ASV (Air to Surface Vessel) search set. This employs the fully rotating dish antenna mounted in a radome. For this type the RO has a circular PPI (Plan Position Indicator) scope that provides him with a maplike representation of the area below, clouds and darkness notwithstanding. The operator can discern land features such as peninsulas, headlands, or islands as far as 150 miles away; ships can be picked up 50 miles distant, and a fleet can be spotted at twice this distance. A switch is used to open the center of the scope to reveal the detail of targets close at hand. The newer ASV sets, are so sensitive that a well-trained RO can detect cloud formations and weather fronts.

The use to which this search set can be applied in bombing should be obvious. In the dark of night, in fog, or through heavy layers of clouds, the PPI tells the operator what is below and thus enables him or the navigator to see landmarks and spot the bombing target. The regular search set is used for these BTO (Bombing Through Overcast) operations, in combination with an H2X ranging unit and a bomb computer that is part of the Norden bombsight that accomplished such accurate visual egg-laying.

The city that is the target can be picked up 50 miles away by the radar operator in his PPI scan. He directs the pilot over the intercom during the bombing run. As the blob of yellow light and shadow that form the target's pattern slide beneath a heading line and ranging circle that are projected onto the PPI screen, the RO keeps the bomber on course. When the line and circle intersect, he releases the bombs. The "eggs" can also be set for automatic release when the proper point is reached.

In October 1944, when Flying Fortress pathfinders led the formations to raids on Vienna, Klagenfurt, and Munich, the Germans found out that no respite was to be gained from cloudy skies over the Reich. The Japs have since found out that even their foul brand of weather is no guarantee against Superfortress visits. "Micky," as the American version is called, is good for BTO missions anywhere from 12,000 feet to altitudes above 40,000 feet, if we ever have to fly that high.

Another technique was developed by the medium-bomber men of the 5th Air Force

(Continued on page 222)

ATTU

**WESTERN
AIR LINES**



NOME

FAIRBANKS

ANCHORAGE

SEATTLE

GREAT FALLS

HERE'S MORE PROOF OF CHAMPION'S PRESTIGE

● The perfect safety record established by Western Air Lines—the nation's oldest—during over three years of pioneer service to arctic war fronts under the Alaskan Division, of the AAF Air Transport Command, is officially credited to "efficient maintenance and efficient scheduling."

Moreover a plane average of 15.9 hours per day in service was set, and that over rugged

U. S.—Alaska—Aleu-
tian routes, a utiliza-
tion record which
again establishes

the characteristic
dependability of Champion Spark Plugs.

● This and hundreds of other extreme wartime services in which Champion Spark Plugs have distinguished themselves provide solid evidence of their better performance and greater dependability. For the Champions you buy for your car today are products of the same research, same basic materials and same precision and engineering standards as the aircraft types, used with such conspicuous success in military and commercial aircraft. When you need new spark plugs demand dependable Champions.

CHAMPION SPARK PLUGS

CHAMPION SPARK PLUG COMPANY, TOLEDO 1, OHIO

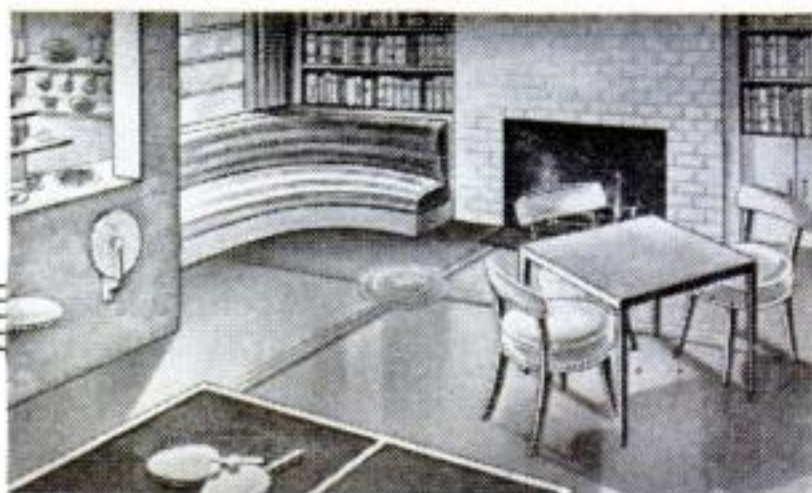
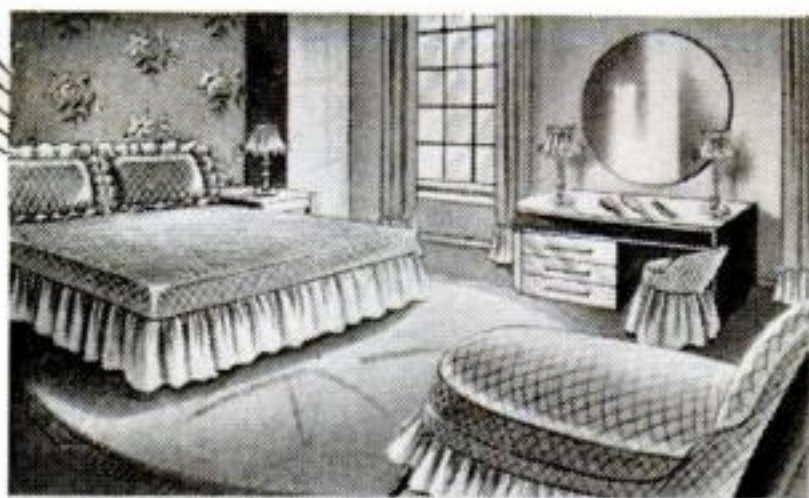


TO SAVE GASOLINE—
KEEP SPARK PLUGS CLEAN



HEAT *that flows*

TO EVERY NOOK AND CRANNY



Is your bedroom colder than you like it on winter mornings? Is your bathroom as warm as you would like it for the early morning shower or the evening tub? Are your halls drafty and cold? Chances are that your home suffers from one or more of these discomforts, which are impossible to cure with the present "on and off" control of heat supply.

But cheer up! There is good news ahead. Moduflow, the amazing new control system developed by Minneapolis-Honeywell, will provide a continuous flow of modulated heat to every nook and cranny of the modern home. It can be easily and inexpensively installed in your present automatic heating system, whether coal, gas or oil.

Before you build your new postwar home, or modernize your present one, be sure to investigate Moduflow. Mail the coupon today for the interesting booklet, "Heating and Air Conditioning the Postwar Home."



SEND FOR THIS BOOK

FREE

Minneapolis-Honeywell Reg. Co.
2912 Fourth Avenue South
Minneapolis 8, Minnesota

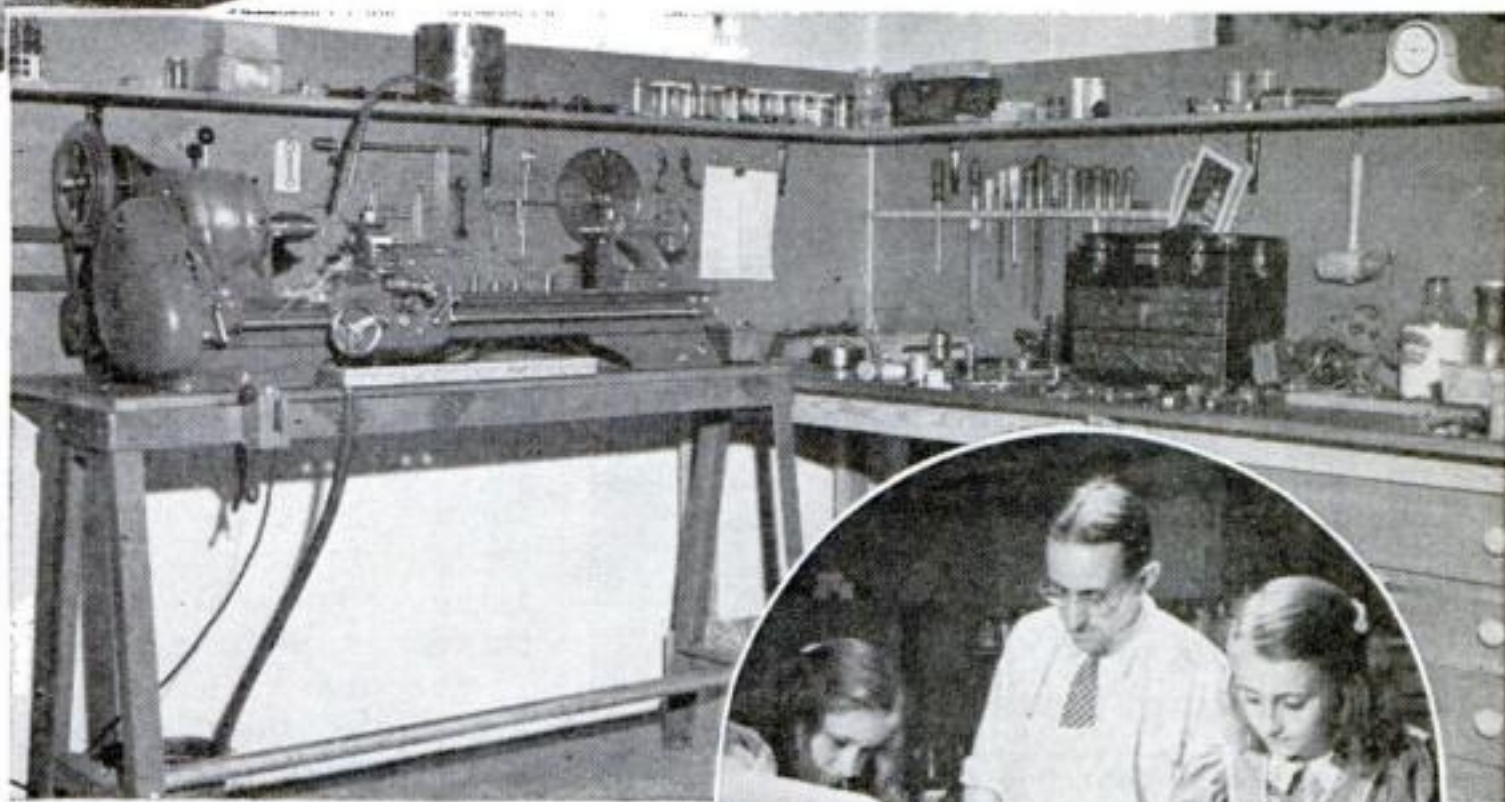
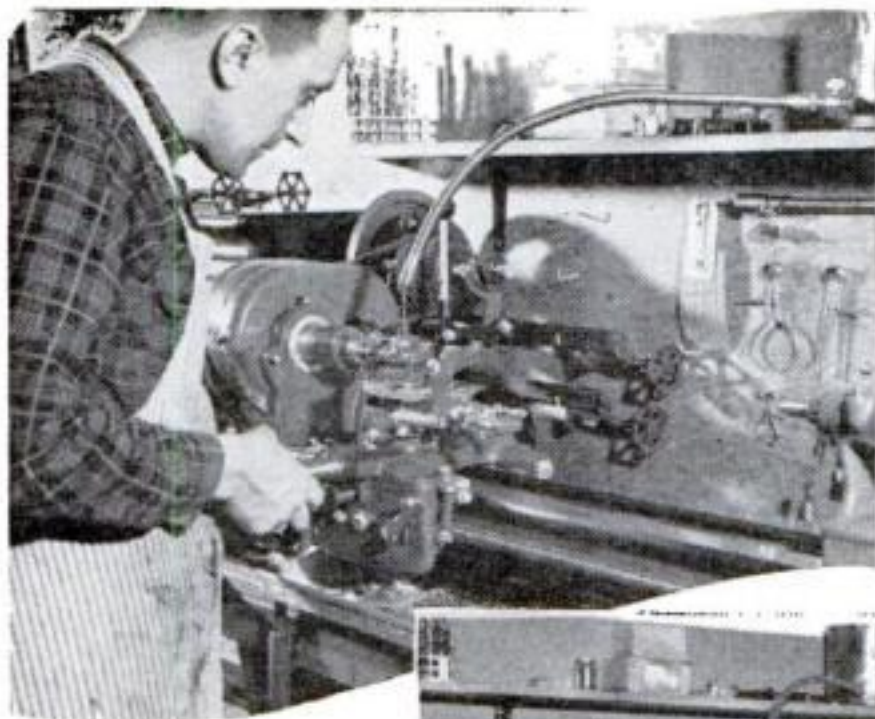
Please send my free copy of "Heating and Air Conditioning The Postwar Home"

Name.....
Address.....
City..... State.....

Let's Finish the Job — Buy MORE Bonds!

MODUFLOW

THE NEW HONEYWELL CONTROL SYSTEM



H. C. RAPP USES HOME SHOP for VITAL WAR PRODUCTION

How a hobby was put to the good use of making over 13,000 radio and special instrument parts is the interesting story of Howard C. Rapp, Mechanical Engineer of Cincinnati, Ohio.

"Homestead Crafters"

Before the war, Mr. Rapp spent many a pleasant and profitable hour working with his daughters on a variety of wood products, using the proceeds to add to his shop equipment. They were getting quite a reputation as the "Homestead Crafters."

When Uncle Sam asked home shop owners to use their tools and talents in war production Mr. Rapp tried, but could find nothing to do on his strictly woodworking equipment.

Worked On Night Shift

So he made the next best contribution and for 15 months worked four nights a week and Saturdays in addition to his important daytime job. When the night shift was taken off, he was told

he could have plenty of work to do at home if he had a metal-working lathe.

With orders in hand he went to the W.P.B., secured a priority, purchased an Atlas lathe and has been busy ever since.

"My only regret," says Mr. Rapp, "is that I did not make such a purchase several years ago . . . I cannot speak too highly of my Atlas. My work calls for close tolerances and I am able to carry out this work in a fast, precise manner."

* * * *

With industry thoroughly sold on the value of subcontracting many men plan to fulfill their life's ambition—a small business of their own—after the war. If that is your plan low cost Atlas tools will help you get started with a small investment.

SEND FOR FREE CATALOGS
Get full details on the Atlas
4 Tool Team—lathe, milling
machine, shaper, drill press.



ATLAS PRESS CO.
955 N. Pitcher Street, KALAMAZOO 13D, MICH.

SAVE WORK!

...Yet Have Lovelier Floors



Self-Polishing Simoniz Shines with- out Rubbing... Gives Longer Lasting Luster

Don't envy others. Your floors can be as brightly spotless as the best of them—and oh so easily! Merely flow Self-Polishing Simoniz onto your floors. No rubbing—no polishing—just let it dry. Then—Presto!—Shimmering loveliness that lasts and lasts. Self-Polishing Simoniz doesn't wash off and have to be replaced every few days. It wears, in fact, much like the original SIMONIZ long famous for enduring beauty on automobiles. Cleaning's so easy, too. A damp cloth whisks off dust and dirt and your floors shine like new again. So, do try Self-Polishing Simoniz—but Soon! Sold by grocery, hardware, drug, paint and department stores everywhere. The Simoniz Company, Chicago, Ill.



SELF-POLISHING SIMONIZ FOR FLOORS

Radar Sees the Invisible

(Continued from page 218)

in the southwest Pacific for attacks against Japanese shipping. Their LAB (Low Altitude Bombing) equipment is connected with the plane's regular set and consists of a computer, a tracking unit, and a repeater scope for the bombardier. LAB can be used from any altitude between 50 and 2,000 feet at night or in conditions of low visibility. And no one knows better than the Japs, who tried to run merchantmen and warships through our aerial blockade, the efficacy of this automatic radar bombing apparatus. LAB is operated in much the same manner as the high-altitude BTO set.

When enemy bombers attempt to attack our ships and ground installations, we put radar to work defensively. Mobile radar sets are hooked up with searchlight synchronizers called "comparators." The beams pick up the planes and aim the lights at them. Accurate antiaircraft fire depends largely upon accurate ranging and computation of speed and direction. Radar can do this as no mechanical computers ever could. In the case of shipboard dual-purpose and automatic 40-millimeter guns, the additional factor of the ship's pitch and roll must be taken into account. This is done through the use of gyro stabilizers that are hooked up to the radar fire-control equipment. Each type of gun aboard ship usually has its own set and antennas; there is one radar for the five-inch guns, another for the 40-mm. guns, and gunnery officers and radar operators and trackers for each of the sets.

The story about radar being used to catch fish is credible because of the effect of microwaves on the delicate sense organs of fish, but radar has been accused of much that is just not so. It will not make operators baldheaded or sterile, nor will it cause RO's to go crazy after being around the apparatus for a time. One woman in the West called a major of the 4th Air Force recently to complain that ever since the AAF put radar on training planes she had been having trouble. When the planes flew over her house, she said, their radar made her telephone hard to hear, made the bedsprings squeak, the radiators get noisy, and killed all the pretty fir trees around the house.

When the time arrives for radar to cease killing either fir trees or Japs, it will become a boon to mankind in the one medium most essential to international goodwill and understanding—communication.

On land, at sea, and in the air, radar can

(Continued on page 226)



1st

with a factory program
for universal service



Henry Ford long ago declared: "A sale does not complete the transaction between us and the buyer, but establishes a new obligation on us to see that his car gives him service."

Early, the Ford Motor Company saw the need for personal service, precision tools, trained mechanics. From all over the world men came to the Ford plant for service method training. In a sense, they took with them part of the factory itself, methods and ideals, and thus Ford service became universal.

Through the development of special-purpose tools and scientific methods, Ford was first to

make it possible for dealers to give service measuring up to the precision built into the original car. Today Authorized Ford Service dealers everywhere have available a complete line of factory-approved tools that mean finer workmanship, greater economy for the car owner. And the Ford Motor Company continues to supervise the training of men who will use these tools.

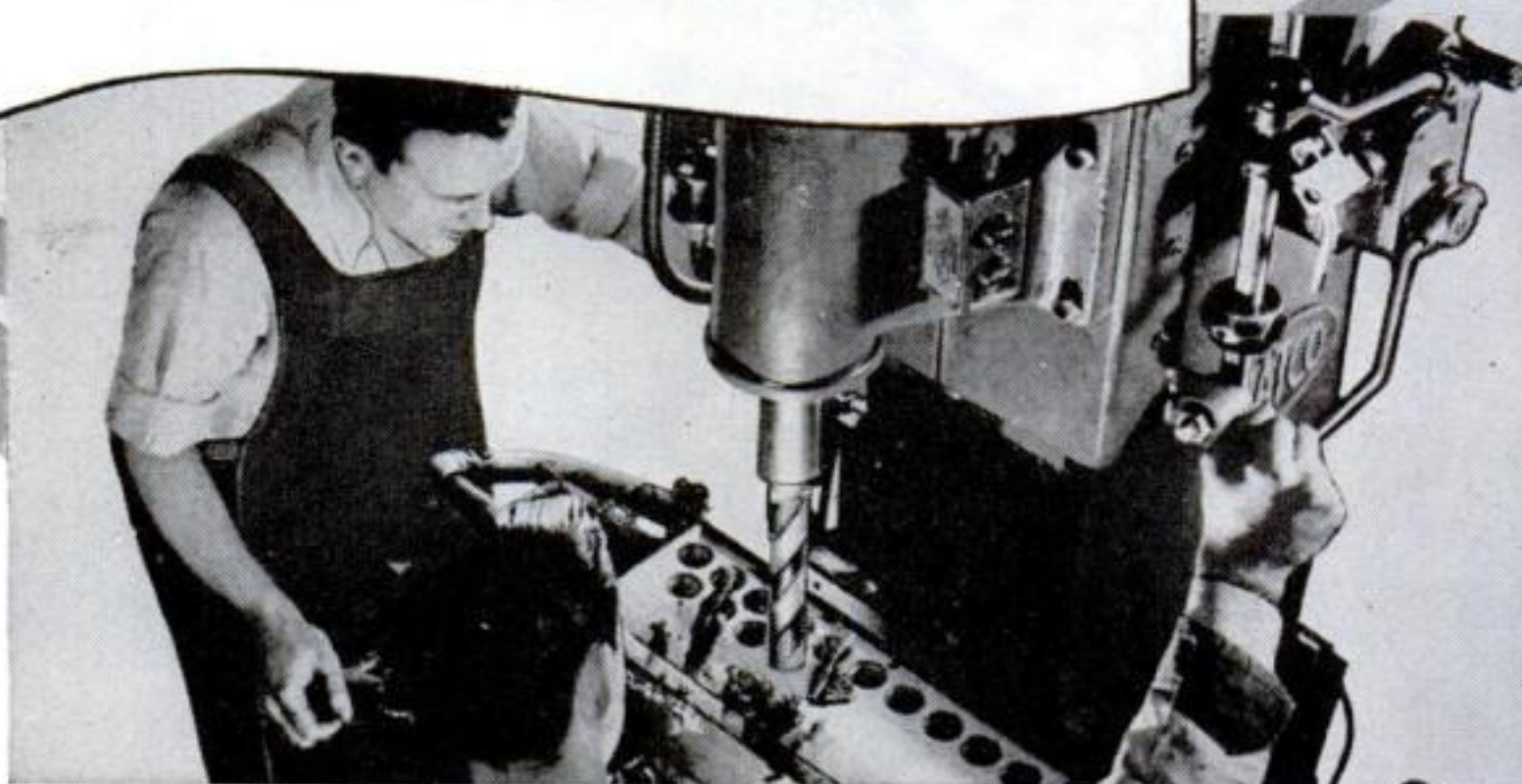
Here is one more of many important Ford "firsts." It is paying extra rewards to owners under wartime driving conditions.

"THE FORD SHOW" Singing stars, orchestra and chorus. Sunday, complete NBC network. 2:00 P.M., E.W.T., 1 P.M., C.W.T., 12:00 M., M.W.T., 11:00 A.M., P.W.T.

EXPECT THE "FIRSTS" FROM FORD!

Ingenious New Technical Methods

Available Now to Industry in General



New Shankless Roll-Forged Drill is Faster, Tougher, More Economical

Developed by Ford for wartime uses — available now to industry in general. "More holes at less cost," is the claim for this ingenious new Shankless high speed drill—made in two parts—the drill itself, and a removable taper shank, known as the "drill driver." By this separation, costs to the user have been cut 20% to 30% under conventional taper-shank drills. In the conventional drill, the shank must be discarded when the point and flutes are worn out. Here, however, the drill driver is used throughout the lives of many drills. Shankless drills are roll-forged and twisted, unlike the machined manufacture of ordinary drills, for improved structure.

Principal advantages are (1) Lower first cost. (2) Greater hole production because of greater strength. (3) Reduced breakage with tough "shock-absorber" neck. (4) Greater length of usable flute. (5) Greater scrap recovery value of unused portion of drill.

Wartime advantages of Wrigley's Spearmint Gum show how this quality product, too, can help industry—once it again becomes available. In the meantime, no Wrigley's Spearmint Gum is being made; and none will be made, until conditions permit its manufacture in quality and quantity for everyone. That is why we ask you to "remember the Wrigley's Spearmint wrapper," as the symbol of top quality and flavor—that will be back!

You can get complete information from
Republic Drill & Tool Co., 322 S. Green St., Chicago 7, Ill.

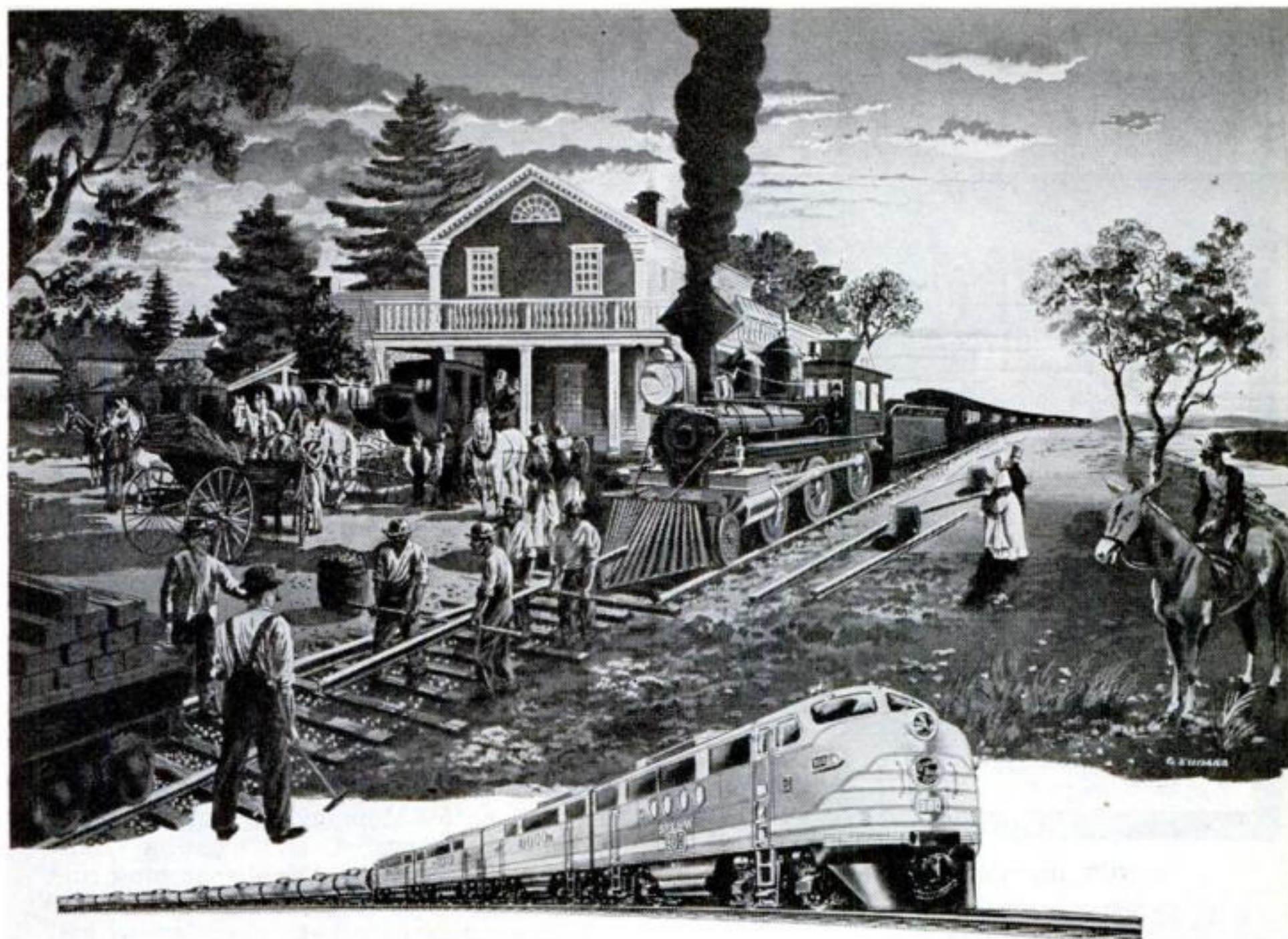


Shankless Drill and "Drill Driver"



Remember this wrapper

Z-81



One of the great dramatic moments in railroading occurred when the Cotton Belt changed the gauge of its 419 miles of track in a single week end. The scene pictured above is our artist's conception of the closing hours of this successful old-time race against time.

CHANGING THE MEASURE OF RAILROADING

It was September in 1886. All along the Cotton Belt, from Bird's Point, Mo., to Texarkana, old spikes came out. Rails were shifted. New spikes sank home under swinging hammers. The entire railroad was changed from narrow to standard gauge over one week end. The Cotton Belt had stepped along with the times.

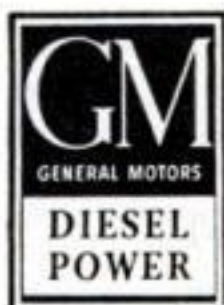
This railroad is still stepping along. It is one of 83 railroads and major industries where General Motors Diesel locomotives are changing the measure of railroading.

Watch what happens when complete lines and systems are GM Dieselized. Far faster freight hauls. Quicker, more comfortable, and more reliable travel for passengers.

And reduced maintenance by sturdiness that goes a million miles or more without major overhaul!

Yes, the measure of railroading is changing — for the better. And GM Diesel locomotives are helping to bring about this new benefit for the railroads, for the country, and for you.

One More War to Win
Buy MORE Bonds



LOCOMOTIVES ELECTRO-MOTIVE DIVISION, La Grange, Ill.

SINGLE ENGINES ... Up to 200 H.P. }
MULTIPLE UNITS ... Up to 800 H.P. } DETROIT DIESEL ENGINE DIVISION, Detroit 23, Mich.

ENGINES 150 to 2000 H.P. CLEVELAND DIESEL ENGINE DIVISION, Cleveland 11, Ohio

SEPTEMBER, 1945

Buy War Savings Bonds and Stamps regularly.

225

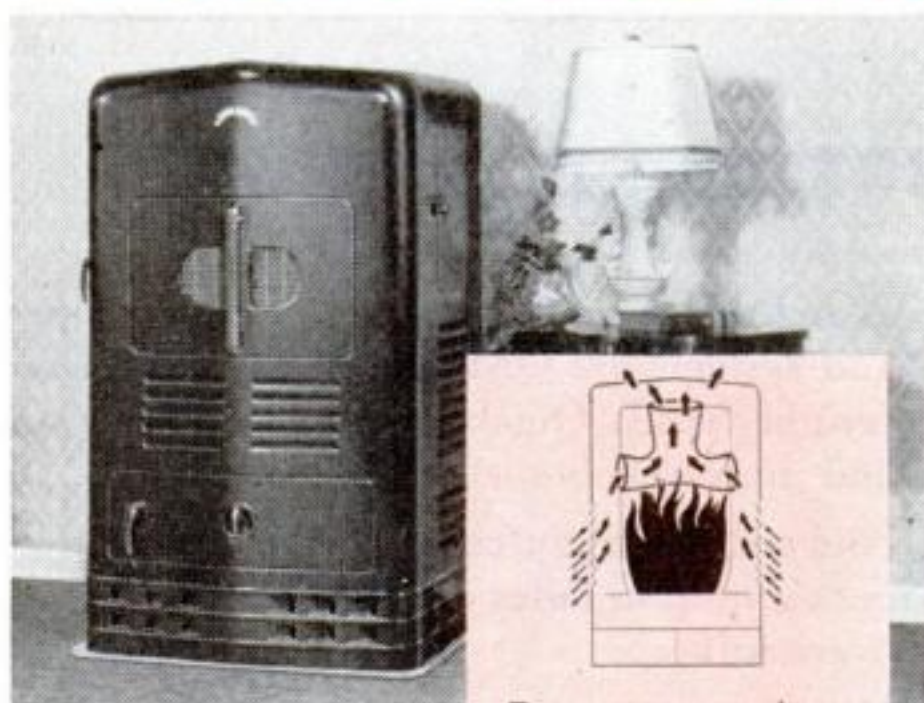
Make this simple test! See why you
GET MORE HEAT



FROM LESS FUEL



with the genuine ESTATE
HEATROLA HEATER



Before you buy any home heater . . . see the genuine Estate Heatrola Heater . . . the recognized leader for over 20 years. Circulates healthful warmth throughout the rooms...makes less fuel go farther. THE ESTATE STOVE COMPANY, Hamilton, Ohio
Your best buy is the best you can buy . . . the genuine

ESTATE *Heatrola* HEATER
FOR COAL, WOOD, OIL

Radar Sees the Invisible

(Continued from page 222)

be applied to all sorts of postwar transportation. It will find its widest application in the aviation industry, because of the three-dimensional character of flying. The CAA is experimenting at Indianapolis with a commercial adaptation of the "BABS" (Blind Approach Beacon System) device used by the AAF and Navy for landing planes in the thickest pea-soup fogs. Airport control officers can be provided with a large master scope that will show, even in bad weather, all planes in the vicinity of the airport. Airlines and personal planes can carry their own navigating and detection equipment to make flying safer and easier.

Steamships equipped with radar navigational and detecting devices can maintain faster schedules in bad weather, locate icebergs and other obstructions, pick up shore lines and shoals, and check on the location of other vessels to avoid collision.

Railroads can apply radar for signaling, the automatic stopping of trains when tracks are obstructed, and locating trains on a master board in the dispatching and traffic-control offices.

Autoists may find that radar devices will enable them to drive at reasonable speeds through fog and storms. One unit might serve as a guide to keep the car on the road, flashing a warning light when the driver gets too close to the edge; another would scan the road ahead for obstructions or other cars.

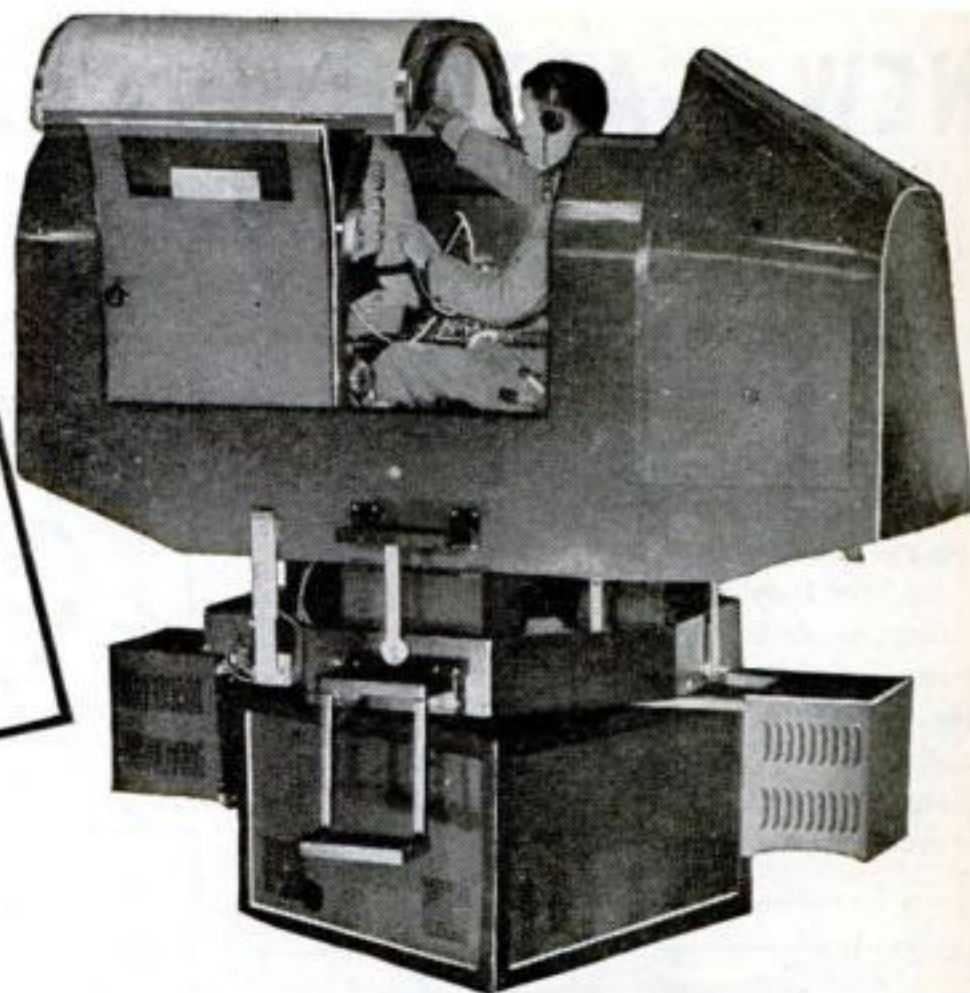
Manufacturers can apply radar in a number of ways. Fisheries can make use of the devices—and certain other apparatus which is not strictly radar but closely allied to it—to locate and catch schools of fish with this "electronic bait."

Indeed, radar may be the most significant contribution to the amazing new electronics industry that bids fair to become one of the keystones of modern living.

MAGAZINES FOR NAVY MEN

The Navy is sending free "Overseas Edition" kits of current magazines to thousands of land stations and ships at sea, and asks relatives and friends of Navy personnel and Seabees not to send private subscriptions to the Pacific. This will (1) ease the tremendous mail load, (2) permit letter mail to go through quicker, and (3) give our fighting men newer magazines.

PICTURED—the Model 45 Link Trainer. The new Elementary Trainer will incorporate the flight-like characteristics of this standard training device.



Coming: NEW ELEMENTARY TRAINER FOR SCHOOL USE

THIS WAR has proved the extraordinary value of training devices—in saving lives, time and money. Our fighting men are the best-trained in the world, due in no small measure to these devices which simulate military problems and help to teach their solution.

The Link was the first training device to simulate the characteristics of an airplane. It is the standard trainer for *all* pilots of our air forces and commercial air lines. Twenty years of experiment and engineering have brought it to a high degree of perfection.

Now Link engineers have developed a new Elementary Trainer, ideal for school and classroom use. It enables students to study the basic elements of aviation—*safely, on the ground*. It is a real Link, with all the flight-like features of the standard trainer. Yet its cost will be well in range for school budgets. It will be available soon after war-time restrictions are removed.

May we enter your name for descriptive literature, to be sent you as soon as it is off the press?

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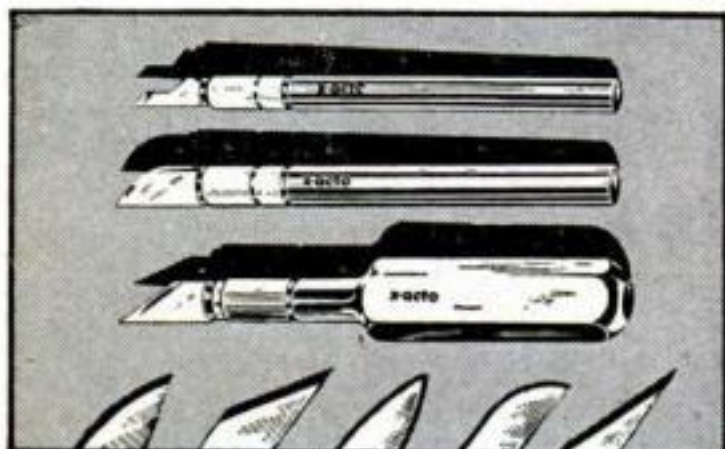
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**SELF-LIGHTING
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Here's the trigger-quick way to do your own soldering and brazing at home. For instance: for REPAIRING ELECTRIC APPLIANCES, KITCHEN UTENSILS, PLUMBING LEAKS, RADIOS, REFRIGERATORS, GARDENING EQUIPMENT, HOUSEHOLD TOOLS, ETC. "go gunning" with the magic Century Gas Gun!

The Century Gas Gun was developed to meet the demands of War Industry for soldering and brazing equipment to speed up production. Now, for the first time, it is available for civilian use. This Gas Gun is absolutely unique—there's never been anything quite like it. Anybody can operate it—with ease, speed, safety. And

with economy, too! For, thanks to the Century Gas Gun, you can now do 101 home repair jobs yourself. The money you'll save on just one job will more than pay the total cost of the gun. Use the handy order-coupon below for quick action!

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* Gun with enough flints for over 2,000 lightings. If you want the regulator, hose, clamps and extension nozzle, send \$17.30 additional. Your local gas distributor can supply necessary acetylene tank.



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DROP FORGINGS AND DROP-FORGED TOOLS

(Continued from Page 80)

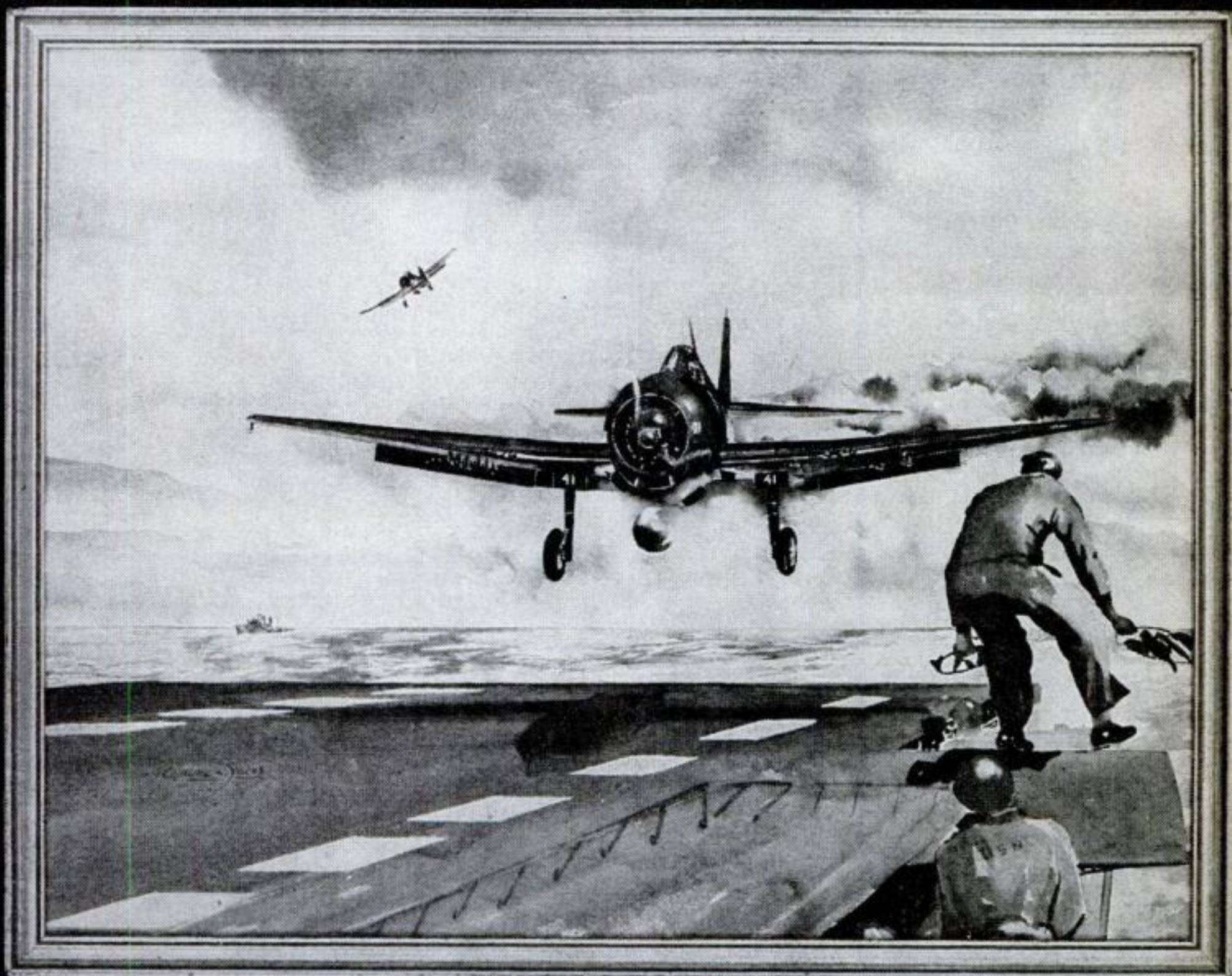
Radiations are known to affect living matter. Radium and X rays, for example, have been used in treating cancer. Hence, some of the biophysical effects of atomic explosions may be beneficial. But others may be gruesome. Persons far enough from an atomic explosion to escape instant death may be fatally injured internally; rescue workers hastening to the scene may also be injured, unless ways are found to decontaminate such areas. *Popular Science Monthly's* editors are confident, nevertheless, that scientists can learn to control this new source of power as they have controlled fire and electricity.

"We have been able to harness this tremendous energy in a small bomb," says Sir John Anderson, who supervised British atomic-bomb research as Chancellor of the Exchequer under Prime Minister Churchill. "That is for war. The first thing now is for the scientists to discover how it can be harnessed for the beneficial purposes of peace. That will be a long job."

As recently as June 1940, authorities estimated that it would take more than 191 years to make a single gram of concentrated uranium 238, the source of energy reported to have been used in the production of the annihilation bomb. How much has been produced is still a top secret, but this can be said: Much more than 191 years' work has been done in five years.

The combined efforts of the leaders in many scientific fields, from many nations, and facilities of many great American industries have made the employment of atomic energy to shorten this war possible. Those same efforts and facilities can contribute much more to the world.

"A door has been opened in the world of science, and what may be on the other side is still to be seen," says Sir John Anderson. *Popular Science Monthly* hopes to describe that scene to its readers as rapidly as developments make this possible. Its editors hope, too, that readers of this magazine will be stimulated to contribute to the new era of science that dawned on August 6, 1945. By splitting the atom, man may have united the world.



**Rugged Construction of the U. S. Navy's Grumman
Hellcat Helped Bring This Pilot Back to Fight Again**

Grumman

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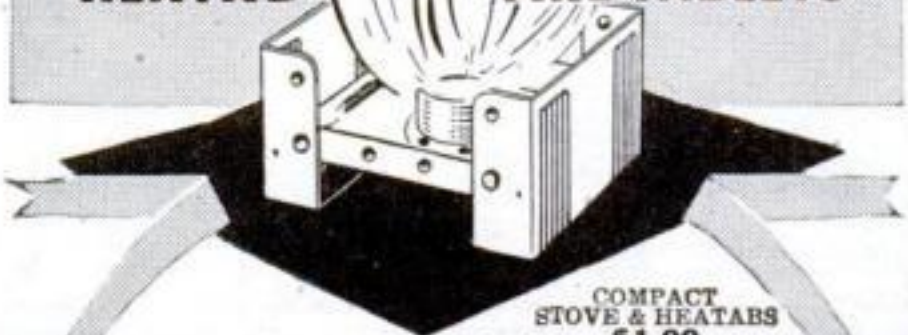


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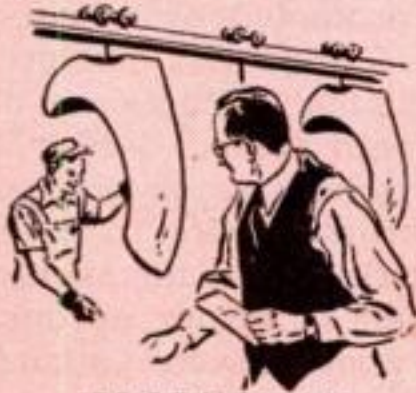
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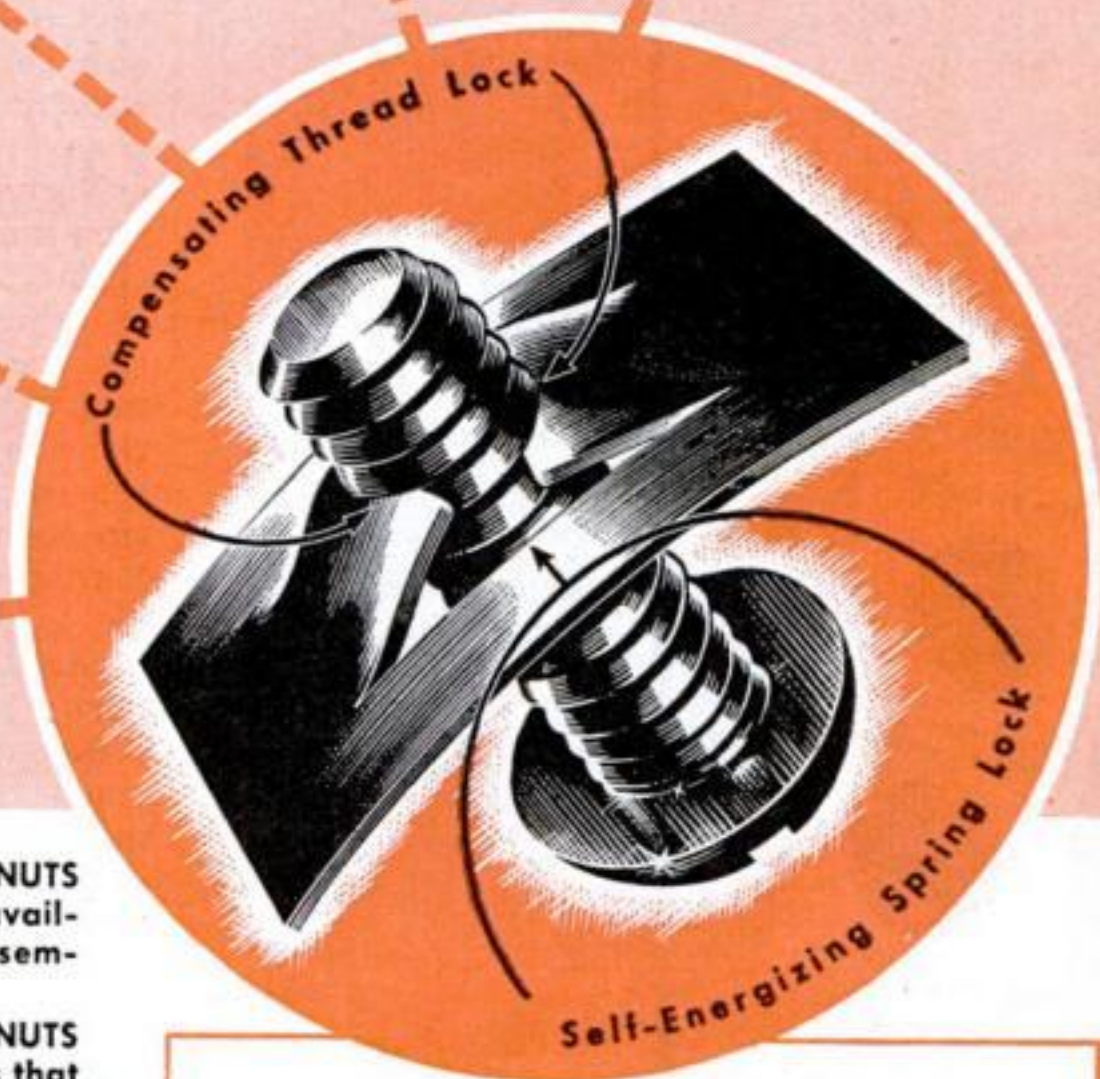
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FIRST with Engineering because SPEED NUTS simplify design problems and are either available, or can be produced to meet any assembly requirements.

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GI's Fight in Armor

(Continued from page 77)

Improvement of all body armor, including that used by flyers, is going on all the time. Two standard vests for airmen, made of overlapping two-inch-square plates of Hadfield manganese steel in fabric pockets attached to a backing of nylon canvas, now are being produced. One of them, worn by bomber navigators, bombardiers, and gunners, weighs 17½ pounds, and protects both the front and the back of the wearer's torso. The other, worn by pilots and copilots whose backs are protected by armor-plate seat backs, weighs 7¾ pounds and protects only the front of the body. Pilots and others who normally remain seated during flight wear groin armor which weighs 15¼ pounds and gives maximum protection to the abdomen and thighs. Other crew members wear either of two models of armor aprons, one of which weighs about seven pounds and the other about five pounds. The pieces making up the various protective combinations are attached to one another by quick-release fasteners which are connected by a rip cord. A single jerk frees the wearer.

One innovation now being tested in service is flyers' armor that combines an increased area of protection with an important decrease in weight.

Seventeenth-century military men who decided that improvements in firearms had made armor a useless and dangerous encumbrance must be stirring uneasily in their graves.

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3-PLENTY OF HEAVENLY HOT WATER...

On tap all the time for baths, housework and laundry—thanks to Perfection's modern Oil-Burning Hot Water Heater. What a comfort that will be!

Due to our war work only limited quantities available at present.

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pick a QUIET motor—a BALLENTINE MOTOR. Because only skilled craftsmanship, strict adherence to close tolerances, *precision dynamic balance* plus modern manufacturing methods and equipment can produce a truly QUIET motor.

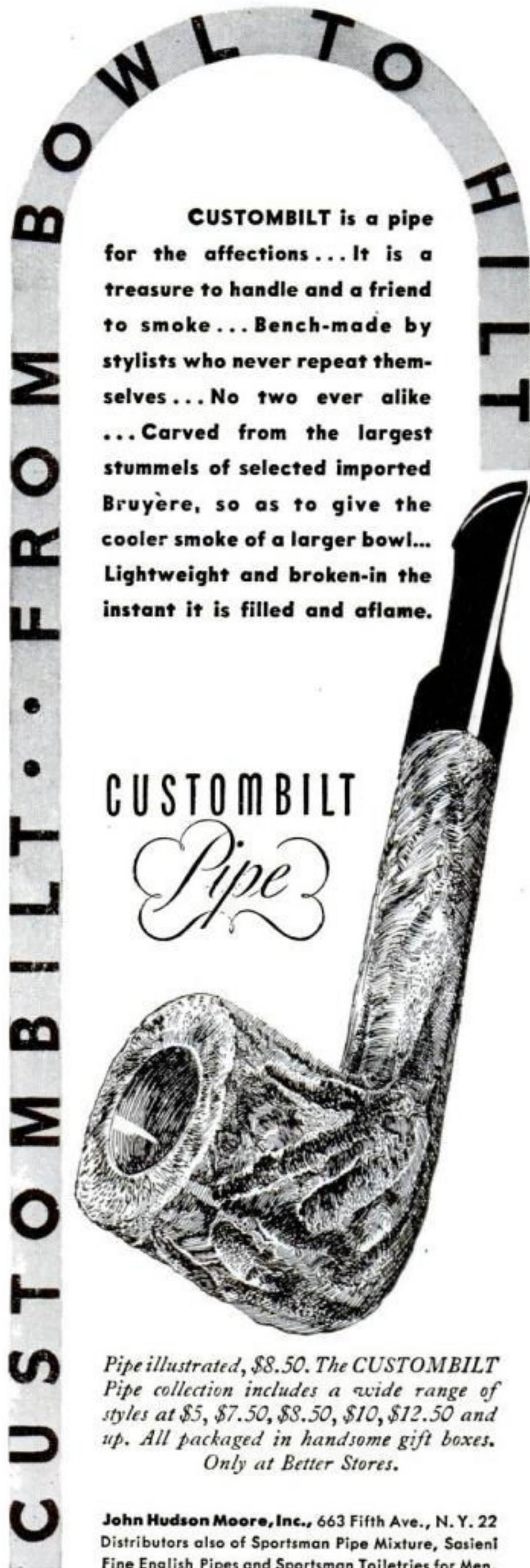
In BALLENTINE MOTORS, the engineer finds all these factors—at *their best*—combined with suitable mechanical and electrical design. *Quiet* BALLENTINE MOTORS are available in ratings from 1/1000 to 1/6 H.P.—adapted to your specific application.

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CUSTOMBILT is a pipe for the affections... It is a treasure to handle and a friend to smoke... Bench-made by stylists who never repeat themselves... No two ever alike... Carved from the largest stummels of selected imported Bruyère, so as to give the cooler smoke of a larger bowl... Lightweight and broken-in the instant it is filled and aflame.

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Pipe illustrated, \$8.50. The CUSTOMBILT Pipe collection includes a wide range of styles at \$5, \$7.50, \$8.50, \$10, \$12.50 and up. All packaged in handsome gift boxes. Only at Better Stores.

John Hudson Moore, Inc., 663 Fifth Ave., N. Y. 22
Distributors also of Sportsman Pipe Mixture, Sasieni
Fine English Pipes and Sportsman Toiletries for Men.

Kickless Cannon

(Continued from page 87)

The 75, too, can be loaded and fired by two men, but in many situations the heavier ammunition—each round weighs 14.7 pounds—would make the assignment of additional ammunition carriers necessary.

The 57 can be fired from the standing, sitting, and prone positions, or it can be rested on the standard .30 caliber machine-gun tripod. The 75 normally is fired from a tripod, but in an emergency can be fired from a mound of earth.

Three kinds of ammunition are being used: high-explosive, for use against personnel, unarmored vehicles, and such targets as light field defenses; high-explosive antitank shells for use against tanks, pillboxes, and the like; and white phosphorus, good both for smoke and against personnel. The high-explosive projectiles have very sensitive fuses. They will detonate on touching foliage. That makes the recoilless gun an effective weapon against tree-sitting snipers.

The idea of the recoilless gun was conceived by, and the weapon developed under the direction of, the Small Arms Development Division of Army Ordnance's Research and Development Service. Engineering assistance was given by a number of industrial concerns.

The weapon is so new that a doctrine for its tactical use has not yet been formulated. The organization of recoilless-rifle infantry platoons, with a firepower equal to, or even greater than, a field-artillery battery is possible. It may be that the application of the principle will have a profound effect on the development of all artillery weapons—for aircraft, antiaircraft, and naval as well as field-artillery fire.

The recoilless gun is not an unmixed blessing to men at war. While its muzzle velocity is far above that of the bazooka's rocket projectile, it is half or less that of an ordinary fieldpiece built to take the backward kick of propellant gases. That means a reduction in range and effectiveness in the delivery of explosives on a target.

But as a way of boosting the firepower of the infantry, its success has been unquestioned. One excited Jap officer on Okinawa, practically catapulted into the arms of his enemies by gunfire, jabbered away at the interpreter, demanding apparently that he be shown something. The interpreter and the intelligence officer finally gathered what he wanted. He was interested in only one thing—the new American artillery that popped up anywhere and everywhere on the battlefield and broke all the rules of heavy-gun mobility.—DEVON FRANCIS.

★★★★★★★★★★★★★★★★★★★★



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SEPTEMBER, 1945

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There are two kinds of sighs in a pipe bowl... One is a sigh for something better and the other is a sigh of contentment... Otherwise known as Sportsman Pipe Mixture, a choice blend of the finest aged domestic and imported tobaccos... Full-bodied but mild with the tranquil bouquet of harmonious proportions.

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The Champion of Blends

In two pocket sizes: 1 oz. at 20¢ and 1 1/4 oz. at 35¢, as well as two glass humidor jars: 8 oz. at \$1.50 and 16 oz. at \$2.85. Only at Better Stores.



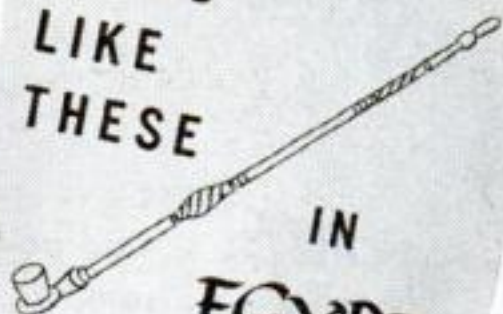
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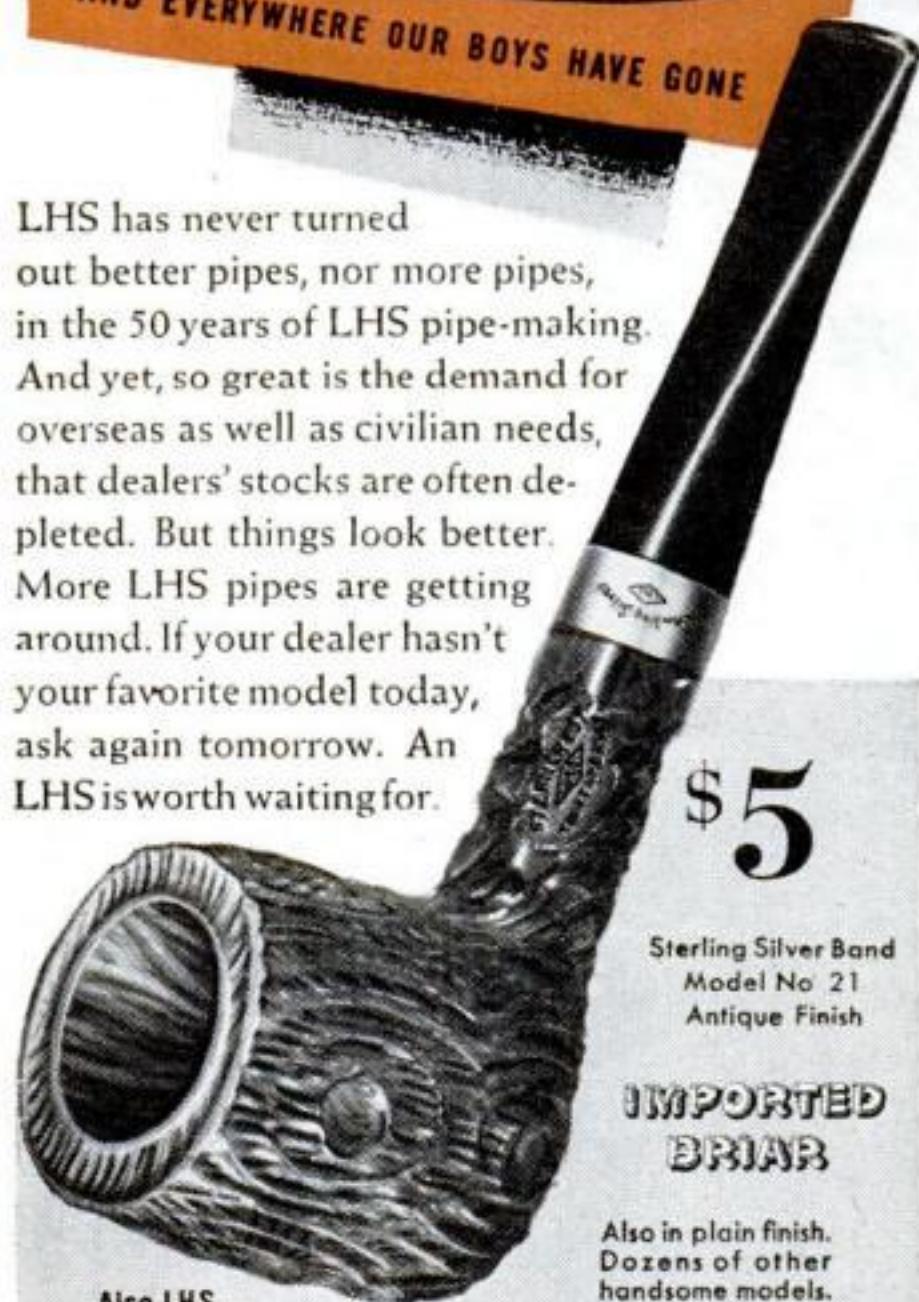
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LHS has never turned out better pipes, nor more pipes, in the 50 years of LHS pipe-making. And yet, so great is the demand for overseas as well as civilian needs, that dealers' stocks are often depleted. But things look better. More LHS pipes are getting around. If your dealer hasn't your favorite model today, ask again tomorrow. An LHS is worth waiting for.



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Just press Kalk-Kord into the crack or hole with fingers; no tools required. Kalk-Kord will not harden, check, or crack. It seals tightly and stays tight.

Don't wait till cold weather—use Kalk-Kord to seal out winter's cold right now. It cuts heating bills; saves cleaning of walls and drapes due to soot and dust. Use it also to plug and seal holes in wood or plaster. Kalk-Kord is waterproof and can be painted over at once, if desired.

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In accordance with Government regulations, STEVENS is producing a limited number of rifles and shotguns in a few standard models for essential uses, to the extent that their production does not interfere with our war work. See your dealer about availability and remember, your new STEVENS is worth waiting for.

STEVENS .22 Cal. Automatic — three rifles in one. One of a great line of STEVENS .22's.

STEVENS double and single barrel Shotguns are famous for durability, dependability and value.

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"... Remember, Joe, it was one of the best shoots we ever had. They started coming over early and you got two sets of doubles out of the first two flights. You really folded 'em up!"

"You bet I remember . . . that was the day I used my STEVENS 620 Pump for the first time and found out what a difference its perfect balance, split-second speed and smooth, straight-back action made on that all-important second shot."

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Joe's right! The right gun makes a difference! Ever since STEVENS pioneered the development of repeating shotguns nearly 40 years ago, STEVENS "pumps" have been famous for sweet handling, dependability and value. J. STEVENS ARMS COMPANY, Chicopee Falls, Mass. Division of Savage Arms Corporation. Manufacturer of STEVENS and SPRINGFIELD Rifles and Shotguns.



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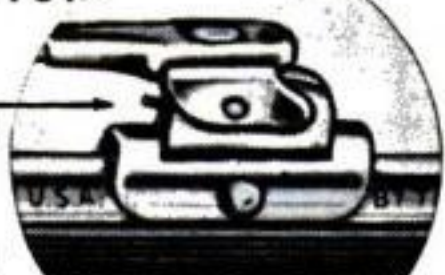
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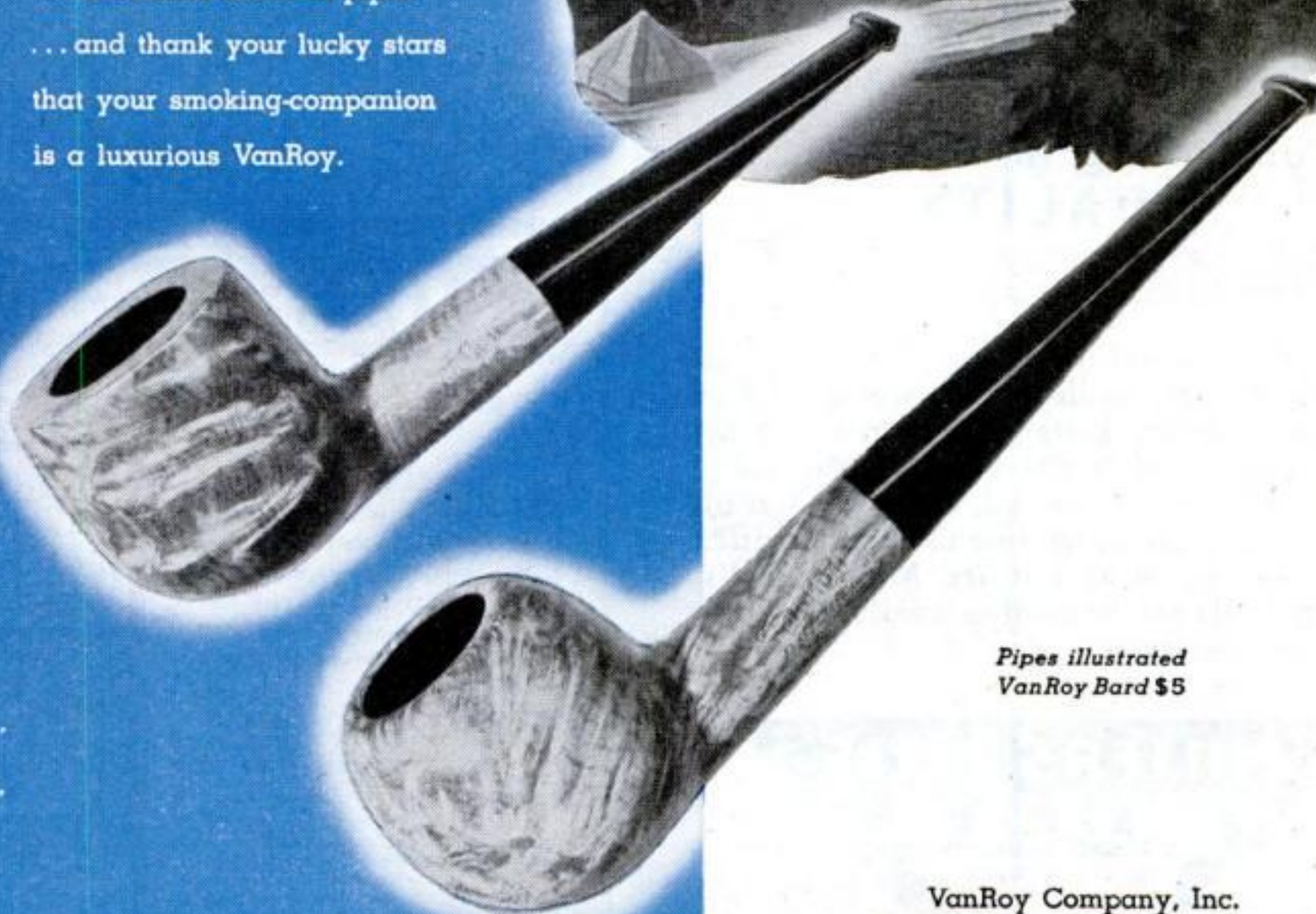


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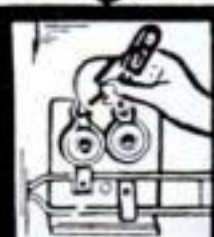


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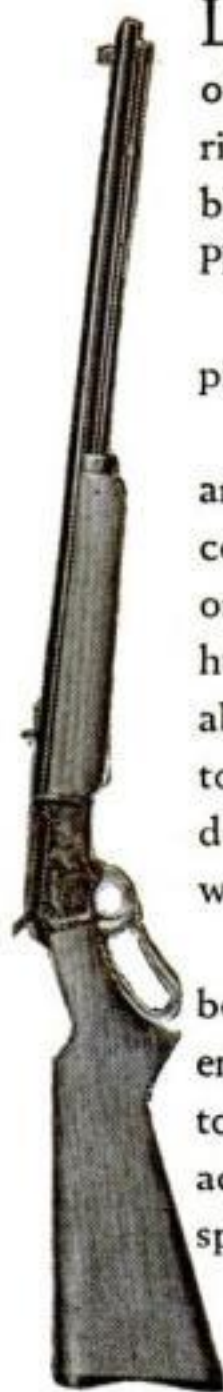


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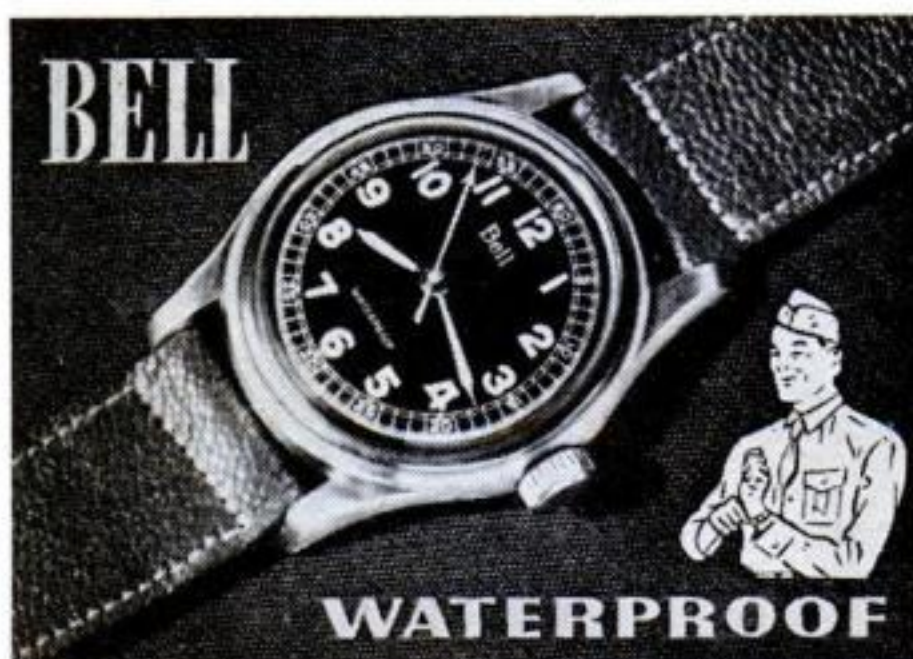
Liberated from a Jap prison camp, an army man was assigned to Leyte. According to his letter to Marlin, he was one day invited to visit a small bamboo hut by a Filipino boy who looked to be about sixteen years old. The lad proudly took a rusty Marlin '39' off the wall, and described how he had killed four Japs with it up in the mountains of Leyte.

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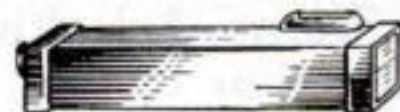


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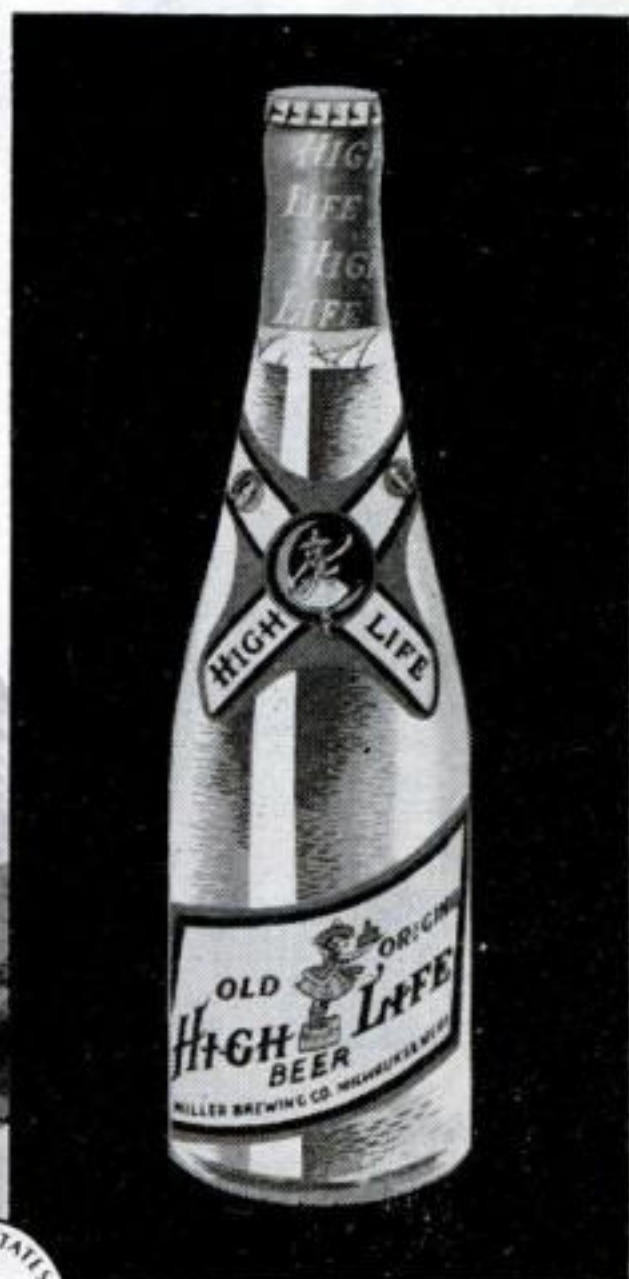
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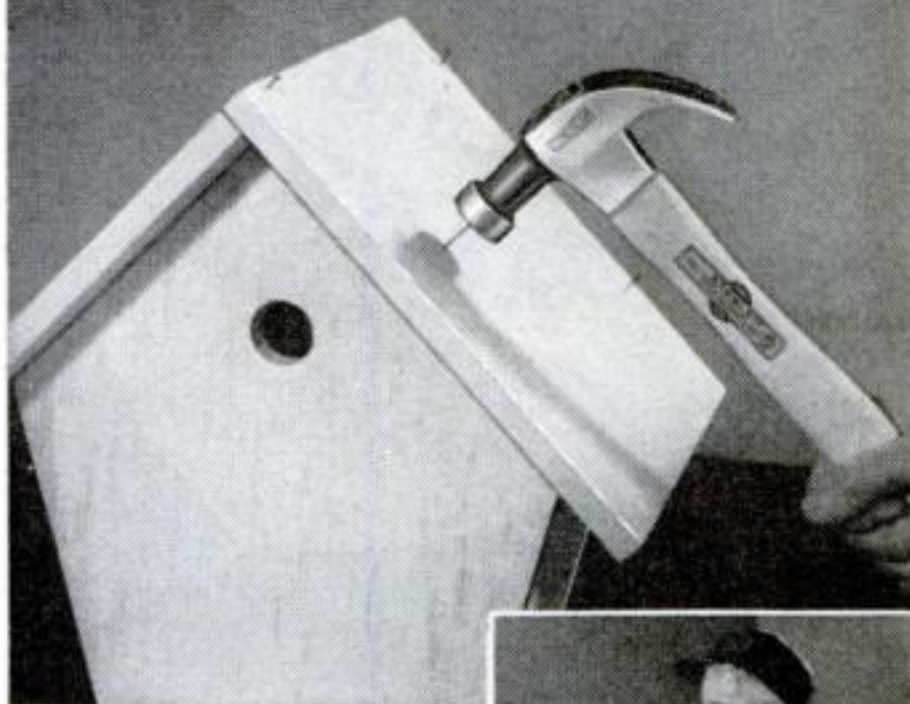
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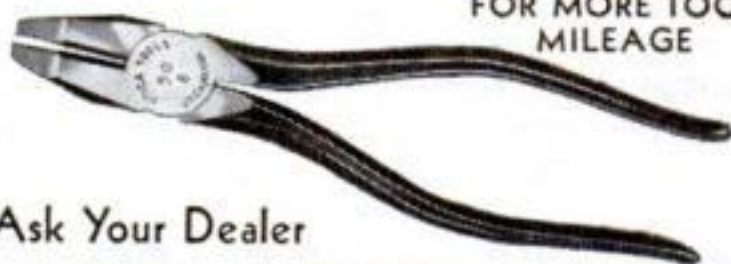


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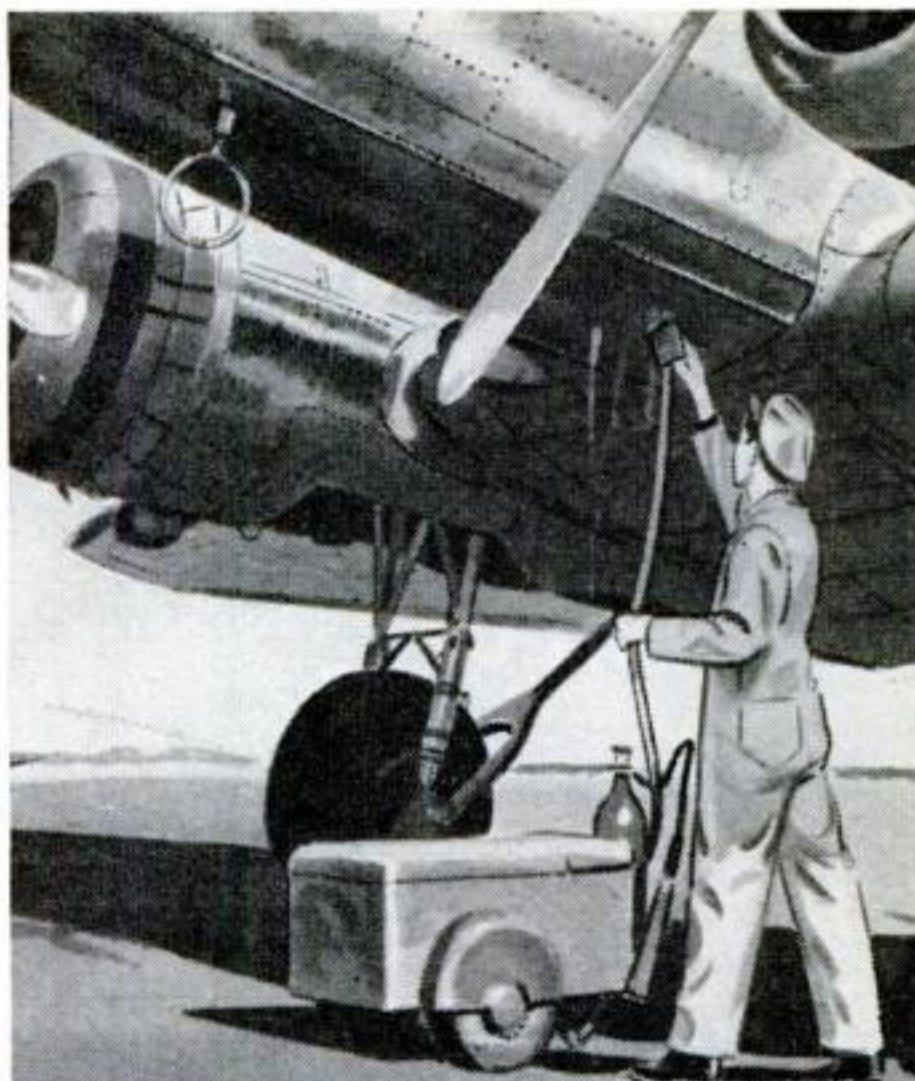
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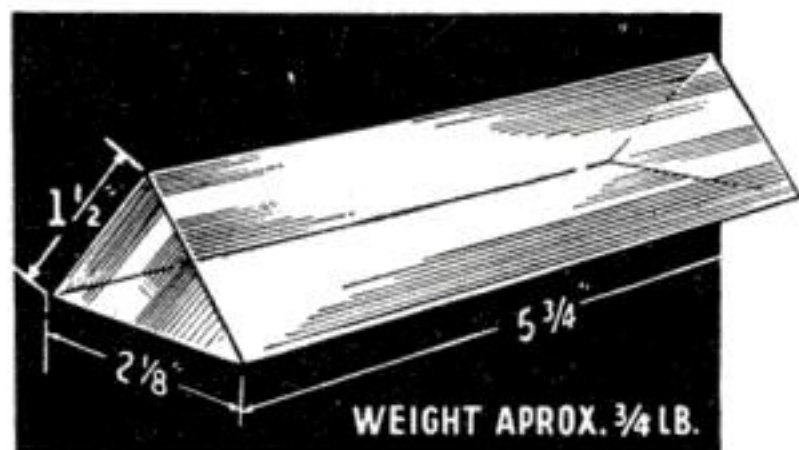
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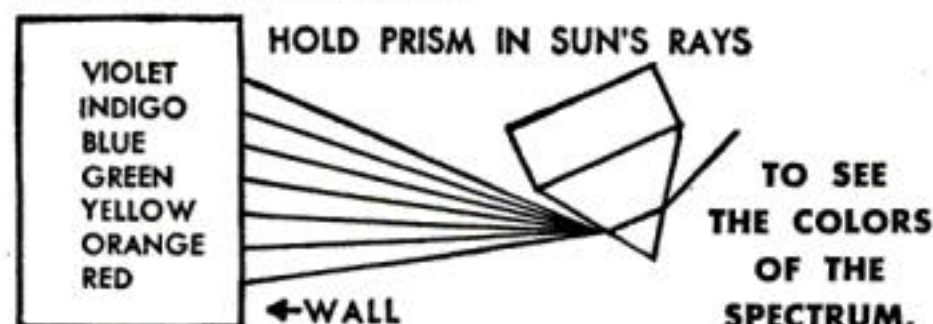


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In order that the tank driver shall not get shot in the face, 2 of these Silvered Prisms are used to make a Periscope. We have secured a number of these, 90-45-45 degree Prisms of huge size— $5\frac{3}{4}$ " long, $2\frac{1}{8}$ " wide, finely ground and polished. Used to build a Periscope, camera stereo attachment, range finder, etc. Excellent also for experiments, classroom demonstrations. Prism easily converted into desk name plate by affixing gold letters. 100 supplied at only 10c. (Order Stock # 3008-N). Normally these Prisms would retail from \$24 to \$30 each.

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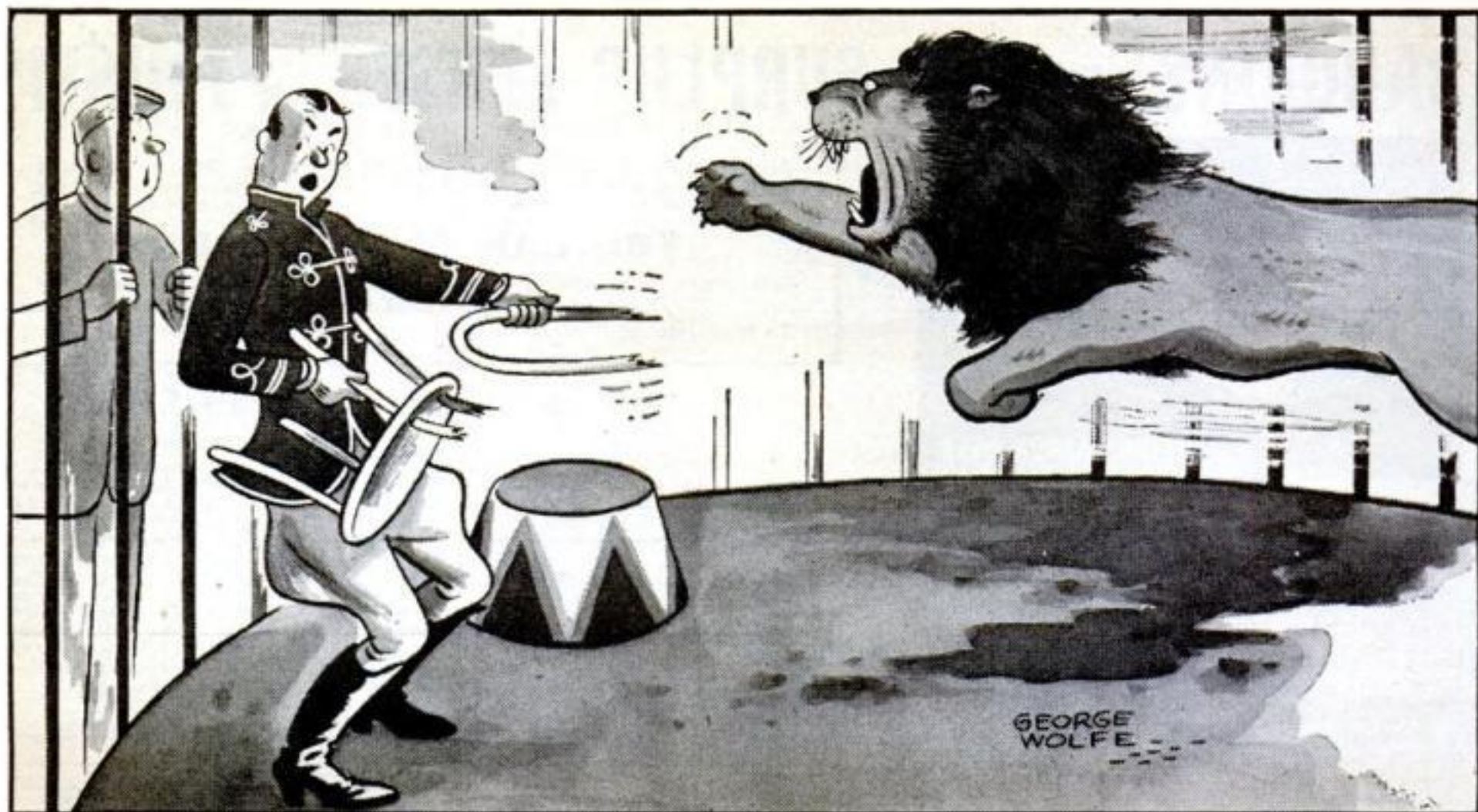
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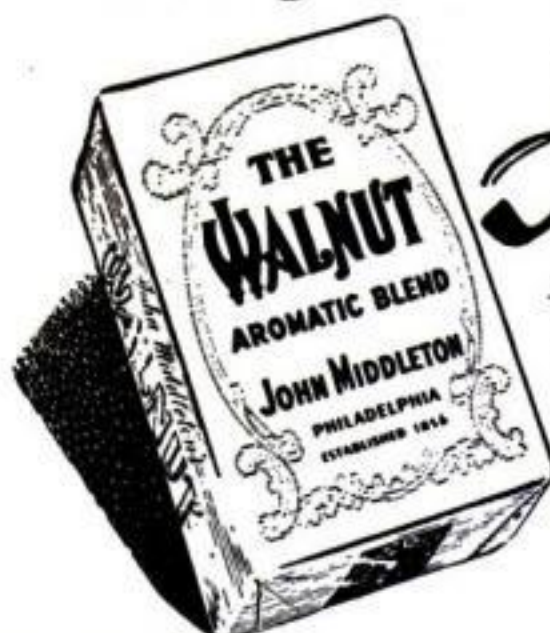
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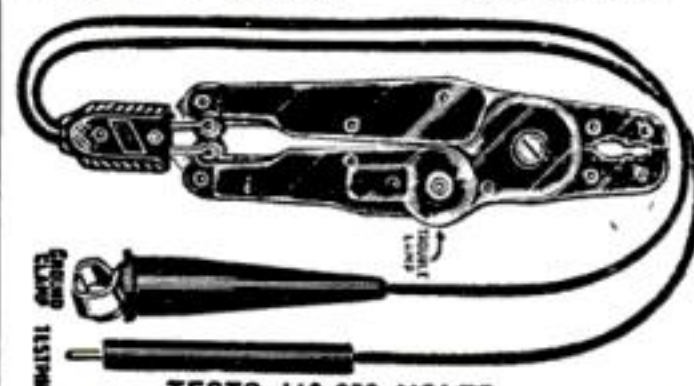
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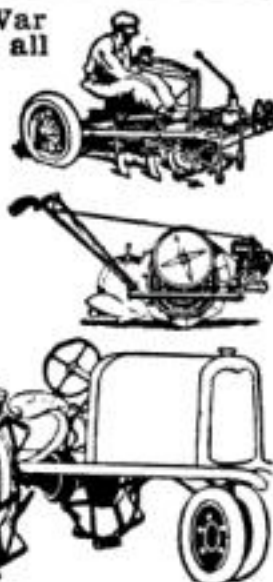
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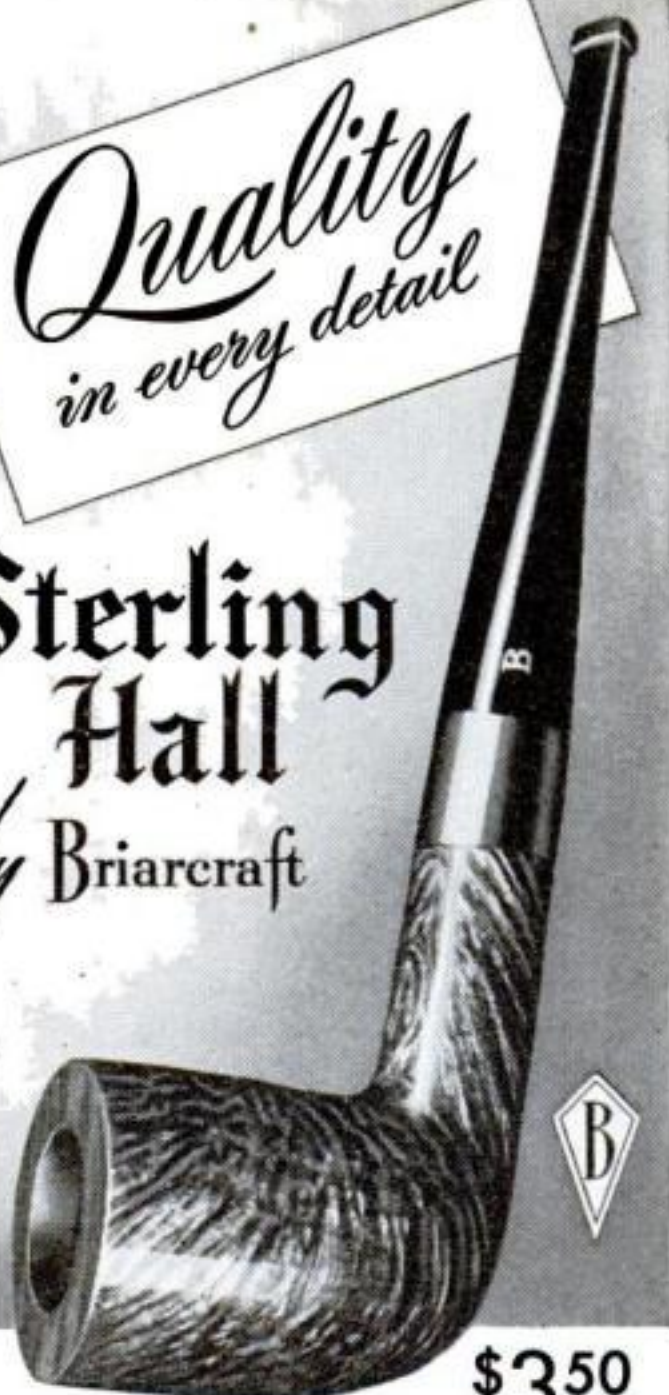


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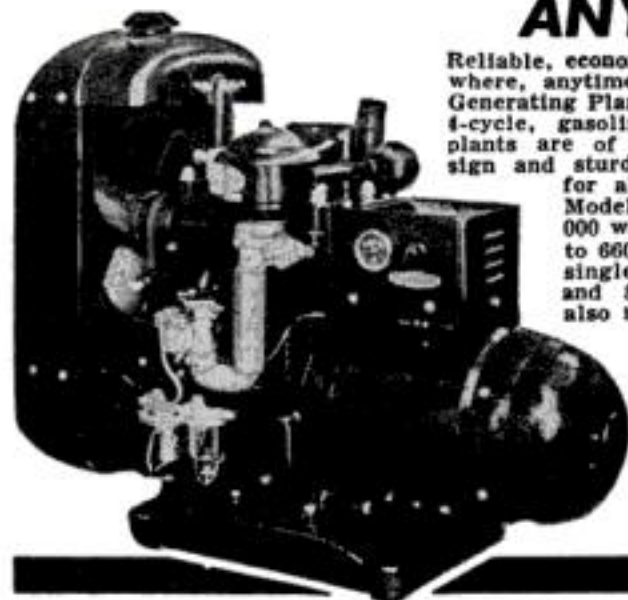
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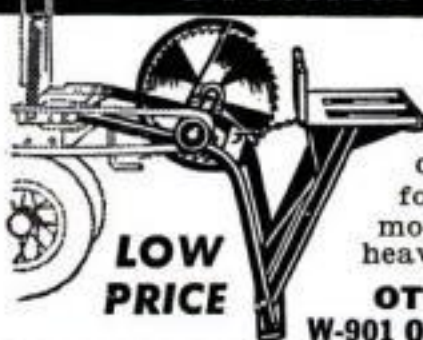
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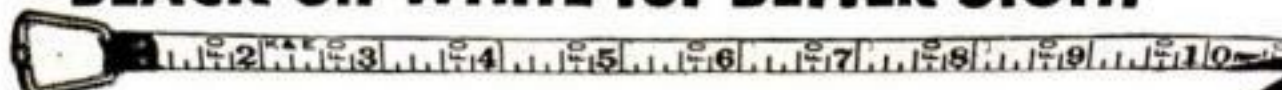


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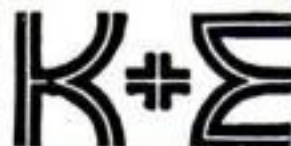


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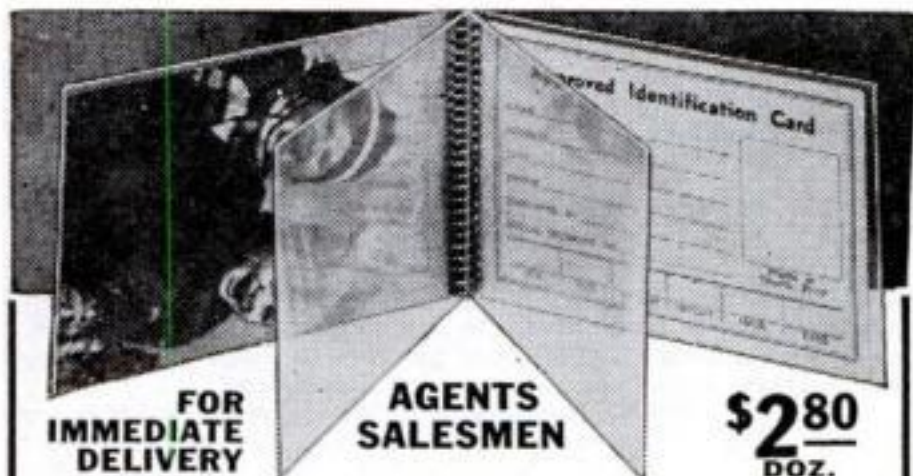
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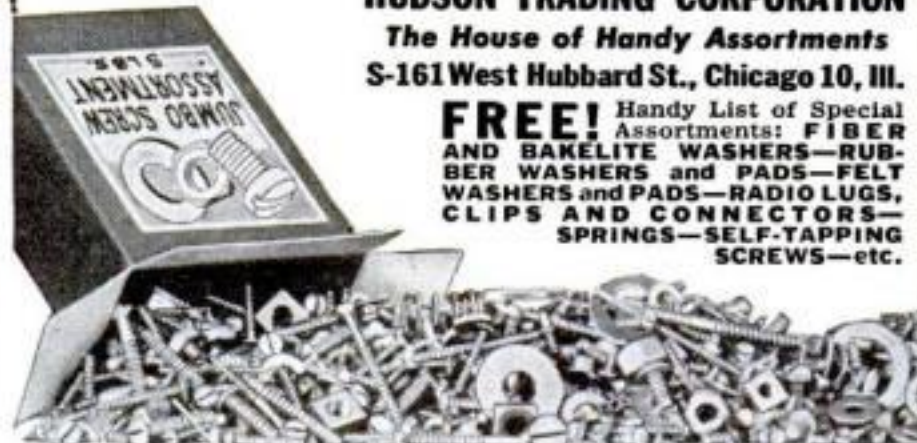
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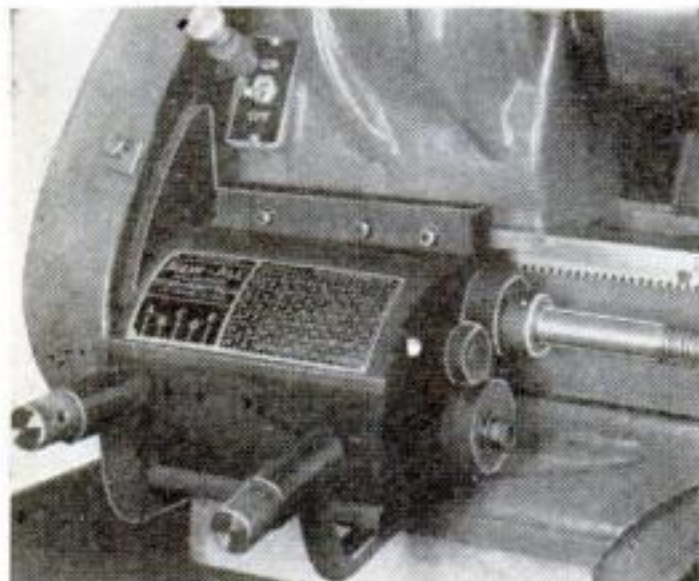


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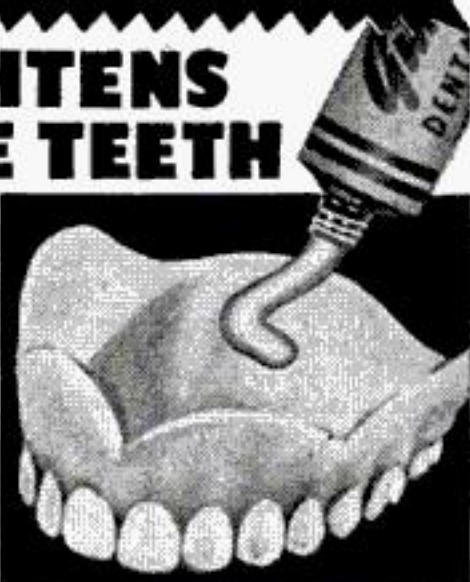
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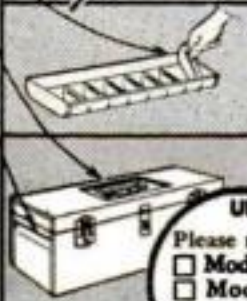


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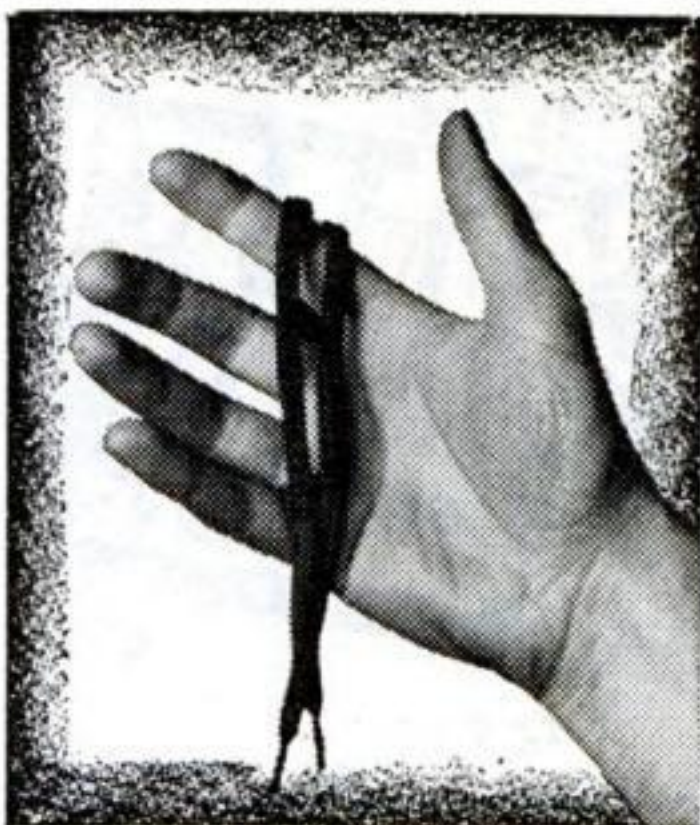


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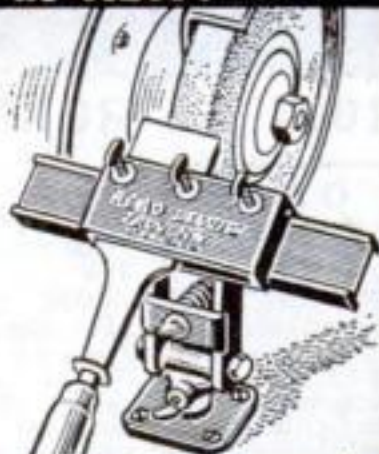
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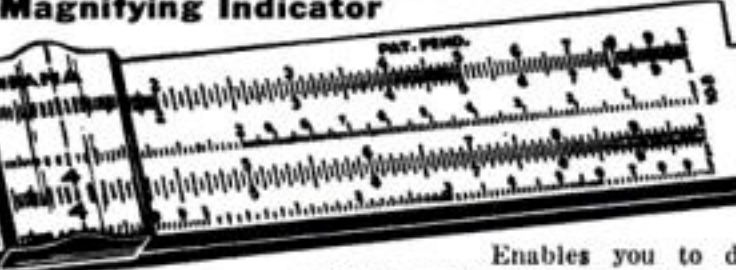
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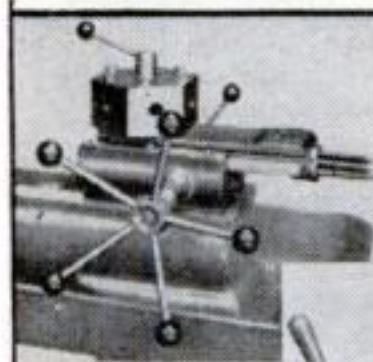
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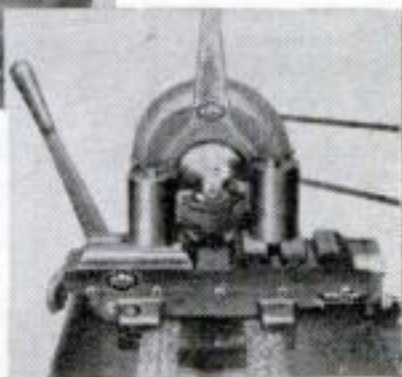
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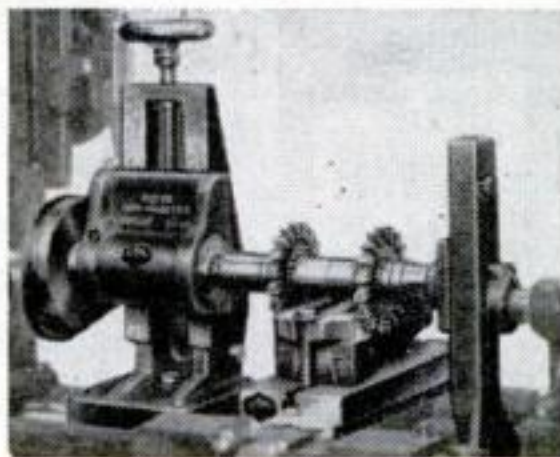


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My name _____

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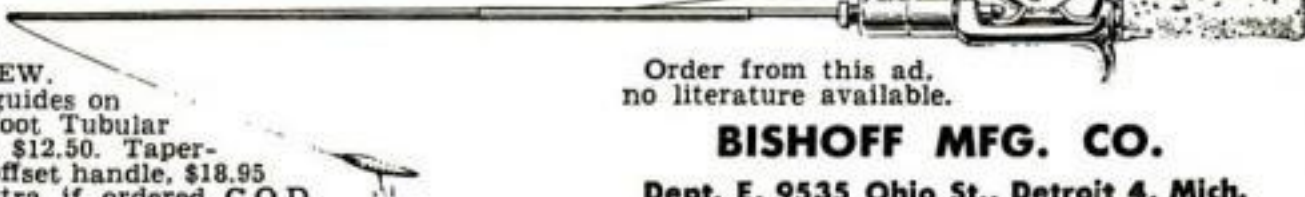
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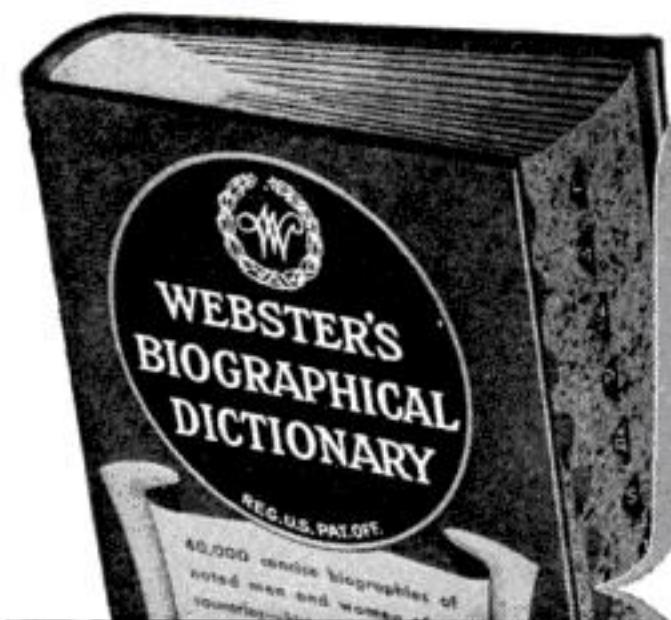
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3/16	3.00	4 1/2"	7/64	11 1/2"		5.00	6"	3/8, 7/16 or 1/2"	2 1/2"
	2.75	3"	11/64	11 1/2"	11/16	5.25	8"	3/8, 7/16 or 1/2"	2 1/2"
	3.00	4 1/2"	11/64	11 1/2"		5.50	6"	7/16, 1/2 or 5/8"	2 1/2"
1/4	2.75	4"	7/32	11 1/2"	3/4	5.75	8"	7/16, 1/2 or 5/8"	2 1/2"
	3.00	6"	7/32	11 1/2"		6.25	8"	1/2, 5/8 or 11/16"	2 1/2"
5/16	3.00	4"	1/4 or 9/32	11 1/2"	13/16	6.50	10"	1/2, 5/8 or 11/16"	2 1/2"
	3.25	6"	1/4 or 9/32	11 1/2"		7.00	8"	1/2, 5/8 or 3/4"	2 1/2"
3/8	3.25	5"	1/4 or 5/16	13 1/4"	7/8"	7.25	10"	1/2, 5/8 or 3/4"	2 1/2"
	3.50	7"	1/4 or 5/16	13 1/4"		7.75	8"	1/2, 5/8 or 13/16"	2 1/2"
7/16	3.50	8"	1/4, 5/16 or 3/8"	13 1/4"	15/16	8.00	10"	1/2, 5/8 or 13/16"	2 1/2"
	3.75	6"	1/4, 5/16 or 3/8"	13 1/4"		9.00	10"	1/2, 5/8 or 13/16"	2 1/2"
1/2	4.00	6"	1/4, 5/16, 3/8 or 7/16"	13 1/4"	1	9.50	12"	1/2, 5/8, 3/4 or 13/16"	2 1/2"
	4.25	8"	1/4, 5/16, 3/8 or 7/16"	13 1/4"		11.00	10"	1/2, 5/8, 3/4 or 7/8"	2 1/2"
9/16	4.25	6"	3/8, 7/16 or 1/2"	2"		11.50	12"	1/2, 5/8, 3/4 or 7/8"	2 1/2"

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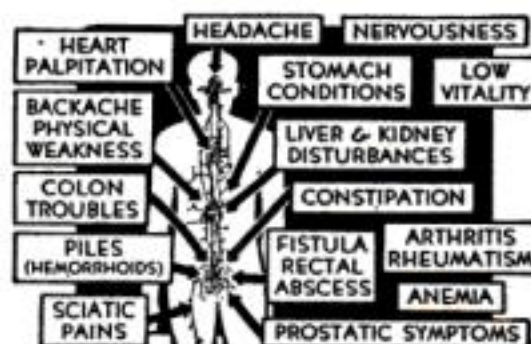


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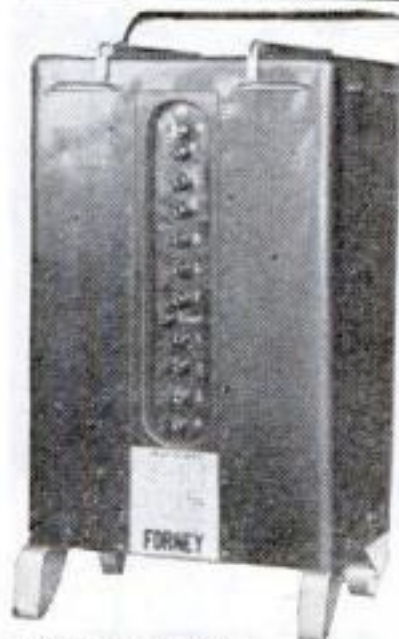
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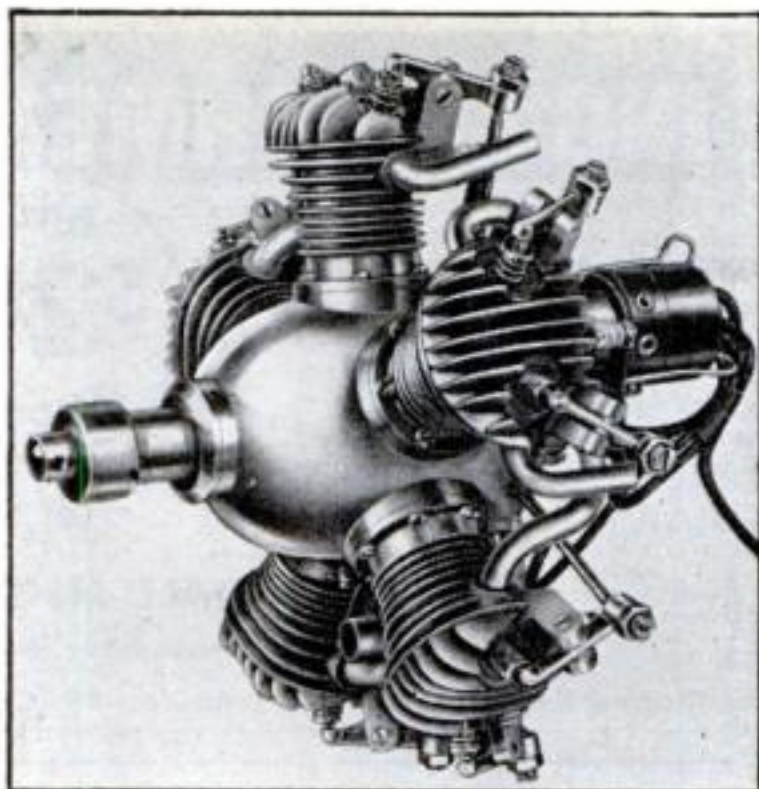
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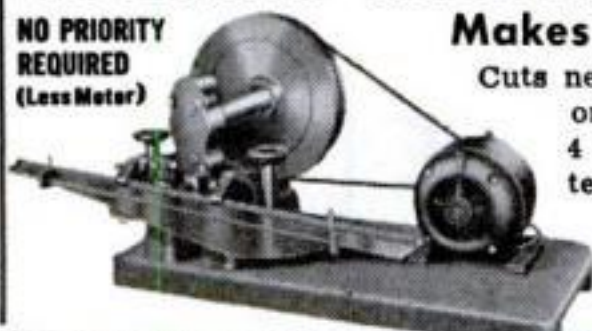
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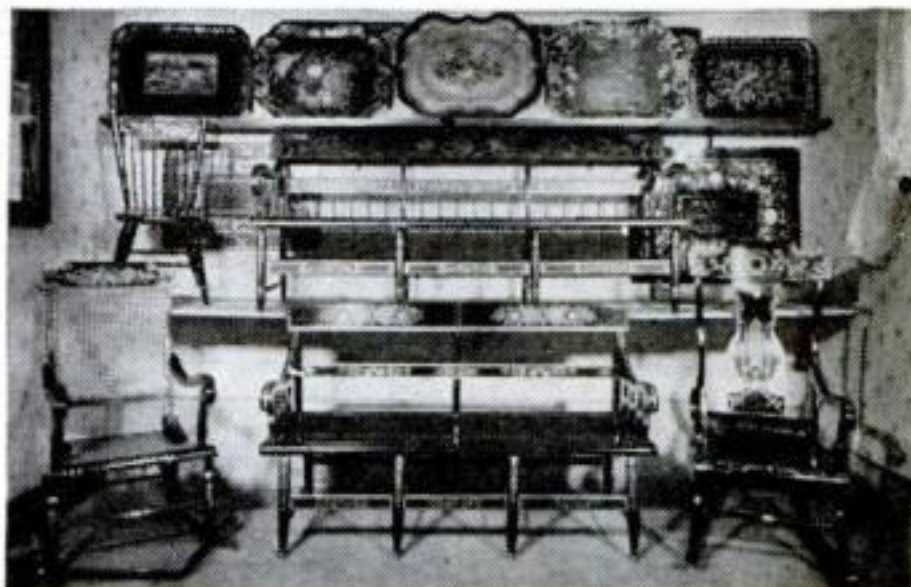
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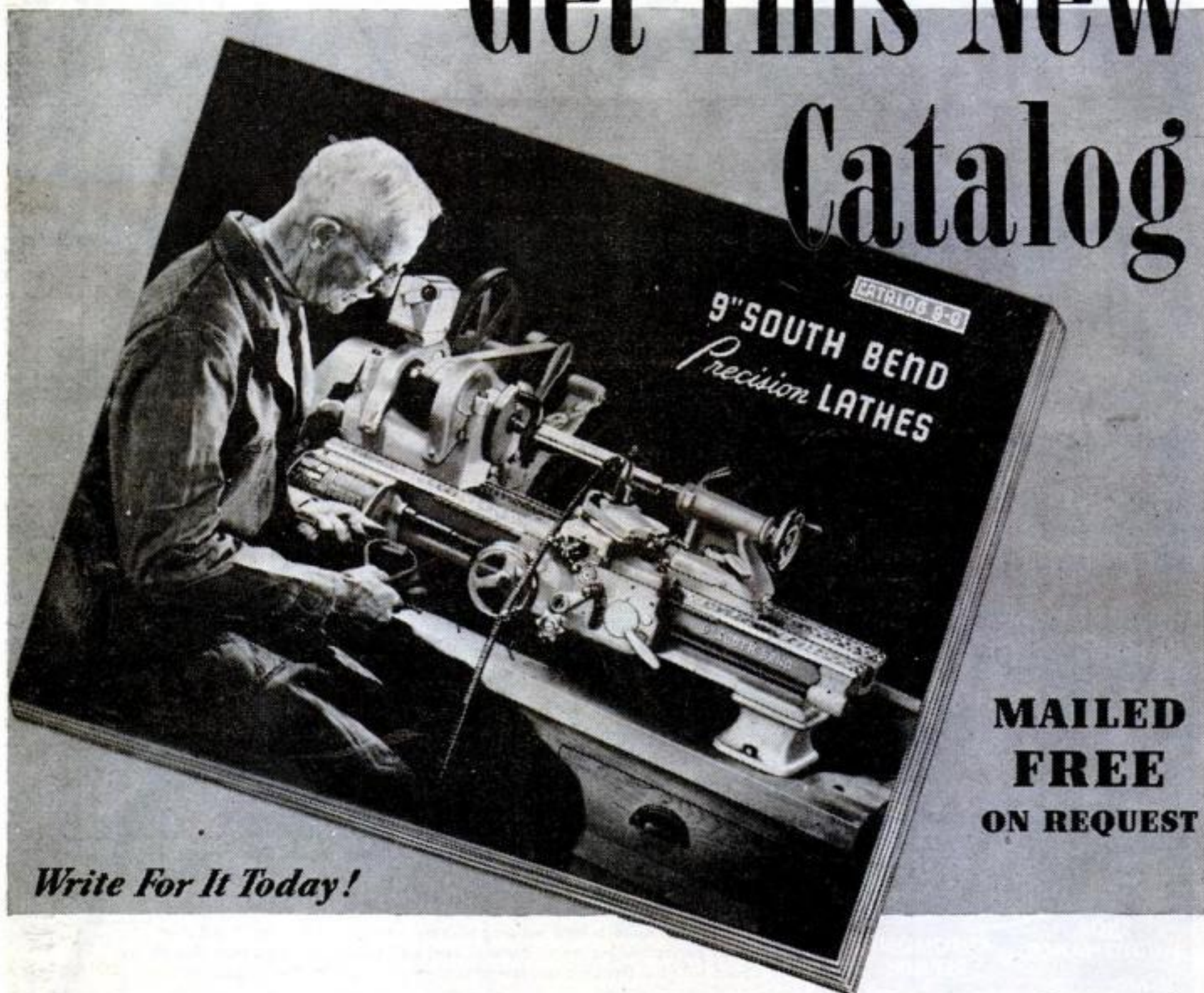


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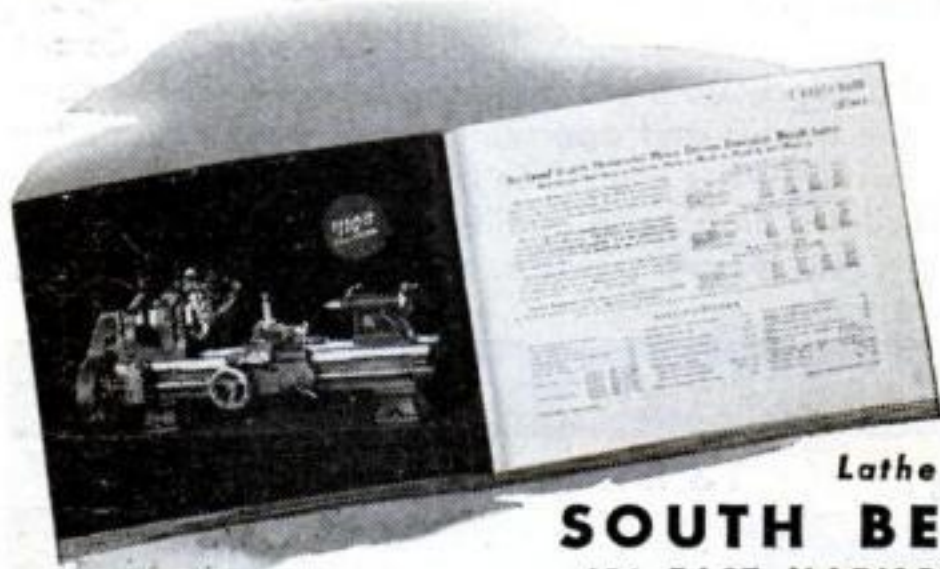
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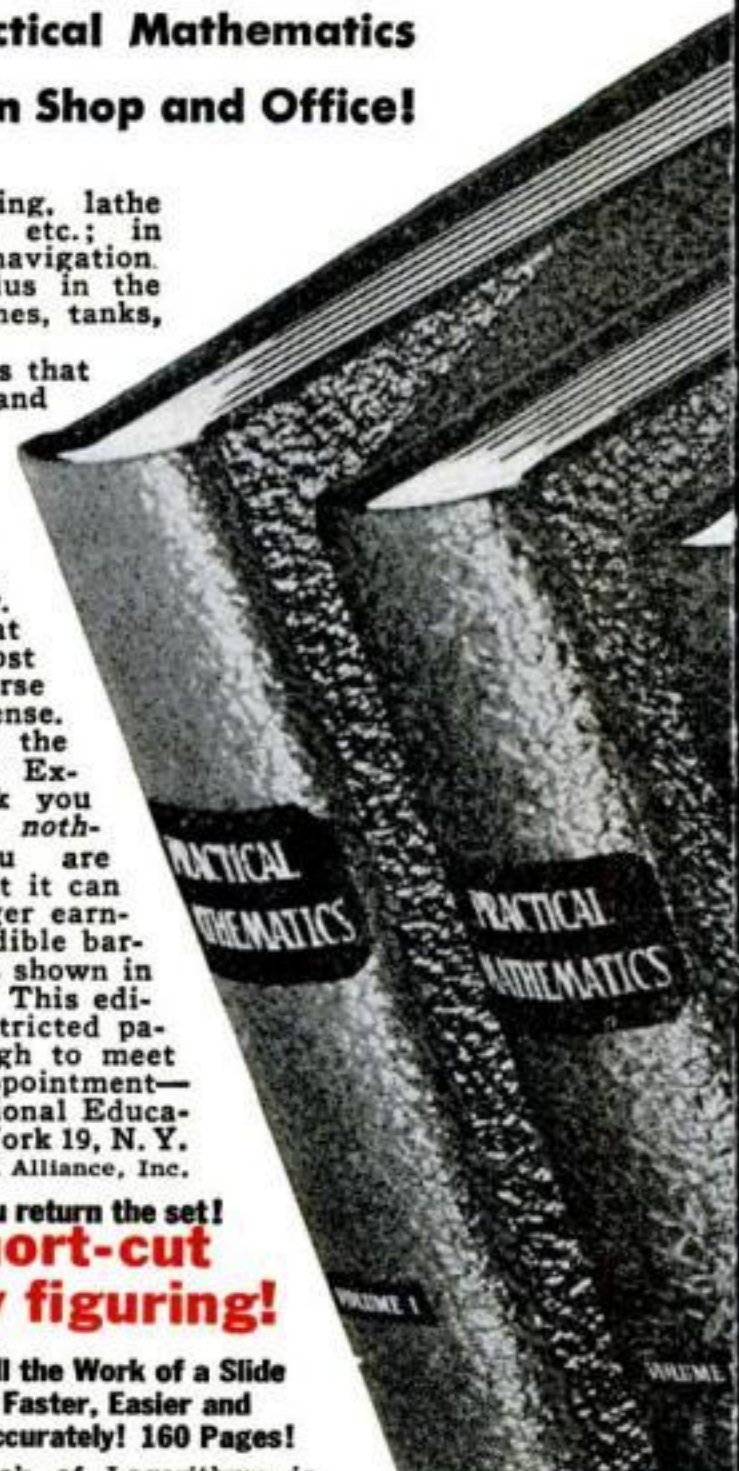
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